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M. R. Bryant

THE HUMAN VOICE

AND

CONNECTED PARTS.

A Practical Book for Orators, Clergymen, Vocalists, and Others.

BY

DR. J. FARRAR,

L.R.C.P. ED., ETC. ETC.

WITH THIRTY-NINE ILLUSTRATIONS.

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PREFACE.

In introducing to the public this work, which was written several years ago, the Author may be allowed to say, that he was encouraged to persevere in the task by the feeling that he was labouring to supply a long-felt want,—a *popular* description, namely, of the organs and parts concerned in the production of the Faculty of Speech; a description, that is, from which all unnecessary technicalities, and as much *dryness* as possible should be excluded, consistent with clearness and the acquisition of a general knowledge of the subject.

There are doubtless thousands of readers, independent of the strictly professional classes, to whom such knowledge—and especially the practical collateral information incidentally treated of in the text—must prove of very great, if not of predominant interest, and no small benefit. Indeed, the practical bearing and application of the facts educed have always been uppermost in the Author's mind, and have been throughout persistently inculcated.

To public speakers, vocalists, &c., much pains have been taken to make the book a kind of Medical Guide or Companion—a sort of VOCAL *vade mecum*, to which reference may be made for information relating to the minor troubles, and some of the graver diseases, to which the vocal organs are liable, as well as the treatment of the more common ailments. This portion of the book will, it is believed, prove not the least acceptable and valuable of the whole.

Throughout the work will also be found a great number of useful hints and suggestions for the preservation of the vocal apparatus in health and efficiency. These, it is confidently anticipated, will very much enhance the interest and value of the book.

The illustrations, which have been inserted wherever found to be useful, will still further tend in this direction. Such of these as have been copied from other works are hereby thankfully acknowledged, and the sources will be found enumerated in the list of illustrations.

For any errors or omissions that may have escaped notice, and for other discoverable faults, either as regards the subject-matter itself or its arrangement, the reader's indulgence is craved,—the numerous distracting duties devolving upon a busy medical practitioner being the apology offered for any shortcomings in these respects.

Finally, if the result of my efforts to make this a really practical and serviceable book be as successful as my desire in this particular has constantly been, the object of the production will have been realised.

J. FARRAR.

15*th February*, 1881.

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INTRODUCTION.

Of all the instruments or contrivances that have ever been invented or designed by man, for the evolution of sound and tone, with the view of these being both highly variable in character, and musical in result, none equals in charming simplicity of mechanism, and thorough capability of fulfilling the ends just stated, the apparatus provided by Nature, and concerned in the production of the human voice. None, moreover, keeping in mind this simplicity of structure, equals it in power, range, variability of tone, &c., and in pleasing, refreshing sweetness. In all these respects, every artificial contrivance is as clumsy and inferior to that supplied by Nature to the human species, as were the cumbersome, unwieldy galleys of the olden time, compared with the neat, trim, manageable screw steamers of our modern days. Indeed, the various powers of which the human voice is susceptible result from the simplest possible contrivance; for we may look upon it as consisting merely of two strings, placed on the inside of a tube, these strings being vibrated, and the resulting sounds produced by the passage over them of a stream of air,—the kind of tone evolved being subsequently modified, in various ways, by the action of the contiguous parts,—such as the tongue, the lips, the palate, &c. The human voice, in short, is the outcome of a simple wind instrument, beautifully and ingeniously constructed, and consisting of but one pipe.

Of the consideration of this wonderful apparatus as it occurs in the human system,—its position, size, mechanical construction, physiological action, &c., and of parts in anatomical and physiological relation with it, as well as of the chief diseases affecting the apparatus and its related parts,—it is the object of the following pages to speak. And in discharging this task, numerous practical hints and advices, arising out of the consideration of the subject, are, as occasion offers, freely and plainly set forth, and at the moment the anatomical or physiological matter, having reference to the questions, is being discussed; that is, while the anatomical or physiological facts are fresh in the reader's mind.

On slight consideration it will be seen to be necessary, moreover, to a full and intelligible comprehension of the subject, that, not only should the instrument proper be described, and its mode of action explained, but, since it cannot act independently of certain other organs or parts, it also becomes incumbent upon us to treat with more or less particularity of these secondary parts also. Secondary, however, only as regards the special uses of the organ under discussion, but of vastly more importance to the life of the individual, than the vocal apparatus proper. As we have in the harmonium, or organ, for example, not only the instrument proper, —that is, a set or number of pipes,—but also many accessory parts, such as the bellows, for the collection and subsequent propulsion of air through these pipes, the keys, and their various connections, for the voluntary admission of this fluid into and through the tubes, &c. &c., so, in the vocal and musical organ of man, there must be, likewise,—since it requires for the evolution of sound, a stream of air to be passed through it with more or less force,—some part suited and appropriated for the collection of the required fluid, and also the means or power provided for subsequently forcing it from this reservoir, and through the pipe or tube. This will lead us to a consideration of the lungs and air-tubes,—these acting the part of the bellows above alluded to,—and about which we shall have much to say. Then, leading from these, and formed by the union of the two last, or largest, air-tubes—one from each lung—is the large main wind-pipe, termed the *trachea*, the continuation of which, upwards, brings us to the vocal apparatus itself, or the *larynx*, with its two (strictly, four) contained strings, the *vocal cords.* Then again, at the top of the larynx, and covering its outlet, is the drop-door-like contrivance, termed the *epiglottis.* Next, the expansion at the top of the throat, the *pharynx.* Besides which are also the *hyoid bone ;* the *palate*, and its fleshy process the *uvula ;* the *tonsils ;* the *mouth*, with its contained parts, such as the *tongue ;* and the *teeth ;* the *lips ;* the *nares* or *nostrils*, &c. &c. All these will have to be passed carefully in review. Some of them are of primary importance to vocalisation, &c., others, as the teeth, &c., as simply modifying the character of the voice, being of secondary consideration. But all, whether belonging to the former or the latter class, are replete with the most absorbing interest, from whatever point we view them, and all present so many points of ruling importance to the individual, that no apology is offered for placing them before the reader in aspects which may not at first sight appear to be connected with the subject of vocalisation.

A full and complete description of the organs concerned, directly and indirectly, with the faculty of vocalisation, &c., is thus a description also of the organs of respiration ; and though our subject compels us to treat of the majority of these, in various aspects, and some with more minuteness than would appear at first sight necessary, yet our chief attention will be directed to those parts a full consideration of which will prove of the greatest interest and service to the reader. Our great object in adopting this course is to lay before him such matter as will most conduce to his practical benefit.

PART I.—DESCRIPTIVE.

CHAPTER I.

THE LARYNX, OR SPECIAL ORGAN OF VOICE.

THE larynx is that part of the respiratory system in which the voice originates. It is the expanded portion and continuation upwards, of the *trachea*, or wind-pipe, but differing from the latter in many important particulars :—the chief of these being the presence in the larynx of a number of special contrivances for the generation of sound. It constitutes the last, or uppermost part, of the wind-pipe, and opens a little above the narrow chink termed the *glottis*, into the expanded part termed the pharynx, at the back of the mouth.

In the full-grown adult it measures about two inches or two and a-quarter inches long; its breadth from before backwards at its widest part, where it forms a projection in front of the neck, being about one and three-quarter inches, or more.

It is composed principally of a number of separate pieces, termed collectively, the *cartilages of the larynx*, which constitute the frame-work of the organ, and which are united and held together by *ligaments*, two of these latter being the strings of tissue (the true vocal cords), which emit the sound that originates the voice, &c. These cartilages of the larynx are not, however, *immoveably* fixed together; but have the power, by means of certain muscles attached to them, of performing certain movements one upon another. These movements are necessary for the regulation of the tension of the vocal cords, and for modifying the size and form of the *chink of the glottis*, &c., as we shall eventually and more particularly explain. On the internal surface, the larynx is covered by a thin and smooth membrane, termed the *mucous membrane*, which constitutes, also, the lining of the trachea, &c., below, and also the parts situated above the larynx. The organ is also supplied with nerves, like every other part of the human economy. Those supplying the larynx are of the highest possible importance, both as regards the function of the organ itself, and of that of respiration, and, indeed, of life itself.

The individual pieces of cartilage, some of which are in pairs, and others in single pieces, receive distinguishing names; and these we shall first enumerate and afterwards proceed to consider in detail. The cartilages occurring singly, are respectively:—

The thyroid cartilage.
The cricoid cartilage.
The cartilage of the epiglottis.

Those which go in pairs, are:—

The arytenoid cartilages.
The cornicula laryngis; and,
The cuneiform cartilages.

In all, nine distinct pieces. These we shall describe in the most convenient order, beginning with the first on the list.

I. The Thyroid Cartilage.—This is named from its supposed resemblance to a shield, the word being derived from the Greek θυρεὸς, "a shield," and εἶδος, "form." The thyroid cartilage is the largest piece entering into the formation of the larynx. It consisted originally, before birth, of two distinct halves, which afterwards became united together in front into a somewhat sharp and prominent ridge, constituting that portion of the larynx so readily recognisable, particularly in man, at the upper part of the neck, in front, and termed in the male sex, the *Pomum Adami*, or Adam's Apple. This prominence, according to the superstitious belief of the old anatomists, who gave it this designation, was caused by the apple of which Adam sinfully partook sticking in his throat at this spot. The lateral halves of the cartilage are termed the *alæ*, or "wings." The shape and characteristic appearance of the thyroid cartilage, as one piece, will be best understood by reference to the annexed figure, which gives a front view of the cartilage. The prominent spurs or projections, seen at the upper and lower aspects of the wings, are termed respectively, the

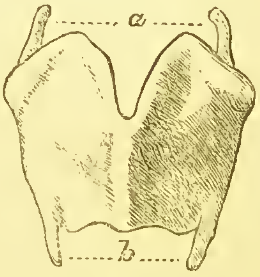


FIG. 1.
THE THYROID CARTILAGE.
Front aspect.—(*a*) The upper horns; (*b*) The lower horns.

upper, and the *lower horns;* or, the *larger* and *smaller horns.* These horns are continuous with the posterior borders, and they connect the thyroid cartilage to the hyoid bone above; and to the cricoid cartilage below. The posterior border of each wing gives attachment to the muscles termed the *stylo-pharyngeus*, and the *palato-pharyngeus.* To them we shall revert when speaking of the muscles of the larynx, &c. The upper horns point somewhat backwards from the central axis of the cartilage, while the lower point forwards; and both pairs, as seen in the figure, incline towards the middle line. Each of the upper horns terminates by a blunt extremity, to which is attached the *lateral thyro-hyoid ligament*, which binds the horns to the tips of the great horn of the hyoid bone above. The lower horns of the cartilage are each provided at the extremity on their inner aspect with a smooth surface, for articulation with the side of the cricoid cartilage, below, and upon this the thyroid cartilage moves like a door upon its hinges. This motion is of the highest importance in vocalisation, and particular attention will be directed to it when speaking of the action of the laryngeal muscles (see pp. 38 and 39).

The external surface of each wing is not uniformly smooth, but is marked by a ridge, which, beginning at a roughened and elevated part, termed the *tubercle*, at the back part of the upper border of the cartilage, takes its course obliquely downwards and forwards, dividing the wing into two unequal portions. To this line are attached certain muscles, which are concerned in the movements of the cartilage, namely, *below*, the *sterno-thyroid* muscle, whose action is to depress or draw down the entire larynx ; *above*, the *thyro-hyoid* muscle, which influences the movement of the larynx upwards ; and to the smooth surface behind, as well as to the line itself, the *inferior constrictor of the pharynx*, whose chief action is upon the pharynx.

The internal surface of each wing, slightly concave, is smooth and polished, and forms, with its companion wing in front, a more or less acute angle, termed the *receding angle*, and into this are inserted :—(1.) The smaller end of the *epiglottis ;* (2.) the *vocal cords ;* and (3.) near the lower border, the muscles termed respectively, the *thyro-arytenoid* and the *thyro-epiglottidean.* The manner in which these muscles influence the movements of the parts to which they are attached, will be better understood after the arytenoid cartilages and the epiglottis have been considered, and the muscles themselves described.

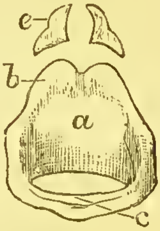


Fig. 2.

(*a*) The cricoid cartilage, posterior inner surface ; (*b*) Articulating facet for the arytenoid cartilage ; (*c*) Front external surface ; (*e*) Arytenoid cartilages.

II. **The Cricoid Cartilage.**—This piece of the larynx is so named from its resemblance to a ring (Greek, κρικος, "a ring"). It is here figured as seen from the front. From this it will be noted that, unlike the thyroid cartilage just described, which is deficient behind, this forms a complete circle. Its broad or deeper part is so placed, with regard to the thyroid cartilage, as to fill up, at its lower part, the gap or deficiency just spoken of as existing in the thyroid cartilage; as will be seen by reference to Fig. 3, which indicates the relative positions of the laryngeal cartilages, both as regards themselves and their relative place to the hyoid bone. The posterior portion of the cricoid cartilage measures, in the male, about one inch in depth; while its front part is reduced to about one-fourth or one-fifth of an inch.

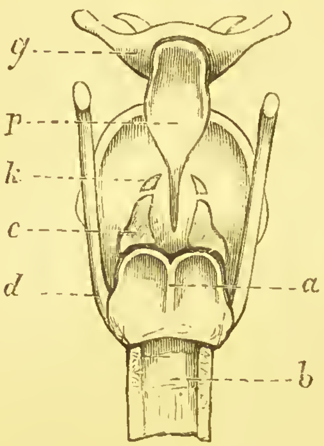


FIG. 3.

VIEW FROM BEHIND OF THE CARTILAGES OF THE LARYNX AND OF THE HYOID BONE.

(*a*) The cricoid; (*b*) The wind-pipe; (*c*) The arytenoid; (*d*) Point of articulation of thyroid with cricoid; (*k*) THE LEFT CORNICULA LARYNGIS; (*p*) THE EPIGLOTTIS; (*g*) THE HYOID BONE.

At the very top of the cartilage, on each side of the central notch, where two smooth facets exist, one on each side of the notch, are articulated the *arytenoid cartilages.* These latter are represented in Figs. 2 and 3; in Fig. 2, *e*, as suspended over their respective articulating facets, and in Fig. 3, *c*, as *in situ.*

To the front and sides of the external surface are attached the *crico-thyroid muscles;* the duty of which is to approximate, *in front*, the two cartilages whose name they take (the cricoid and thyroid); and behind these are attached part of the *inferior constrictor* *muscles of the pharynx*, one to each side. To the ridge which passes down the middle of the posterior external surface (*a*, Fig. 3), are attached some of the fibres of the *œsophagus*, or gullet ; and on each side of the ridge is placed the corresponding *posterior crico-arytenoid muscle ;* while still further from the middle line are the smooth facets, already named, for the articulation of the cartilage with the tips of the lower horns of the thyroid cartilage (*d*, Fig. 3).

The outlet of the cricoid cartilage, at the lower border, is circular, and is connected by membrane to the first, or uppermost ring of the wind-pipe, as seen in Fig. 3. Higher up, the cartilage becomes elliptical from before backwards, which is the shape of the passage through it.

III. **The Arytenoid Cartilages.**—These are so named (Greek, ἀρυταινα,—" a pitcher ") because when taken together, and examined covered with their mucous membrane, they are supposed to resemble a pitcher. They are two small triangular pieces, resting by their bases on the top of the cricoid cartilage, as is shown above at *c*, Fig. 3. One of the triangular faces, the narrowest, looks directly inwards towards the corresponding face of its fellow cartilage, these lying parallel to each other. The two remaining surfaces look,—one forwards, and the other backwards, with the border joining these faces looking directly outwards. The arytenoid cartilages are only of small size, being not more than half-an-inch long, by one fourth of an inch broad at the base. To the posterior surface of each is attached the *arytenoid muscle*, and to the front surface, the *thyro-arytenoid muscle*, and one end of the upper, or false, vocal cord.

The base of each cartilage rests by its inner portion upon the upper and posterior part of the cricoid cartilage, as already pointed out; and to the outer or external angle, which unites together the front, back, and base of the triangular cartilage, are attached the *posterior-*, and the *lateral-crico-arytenoid muscles*. The lower, or true, vocal cord is inserted by its posterior extremity into the front angle; that is, into the point formed by the union of the front, inner, and basic surfaces, and which angle projects prominently forwards for this purpose.

The apex of each cartilage is a little blunt; and to this angle is articulated the somewhat conical piece, one for each arytenoid cartilage,—which is termed the *cornicula laryngis* (*k*, Fig. 3). This appears to be a mere prolongation upwards of each arytenoid cartilage, being in some cases, indeed, continuous with it, and forming with it one piece.

IV. **The Cornicula Laryngis.**—These small conical pieces do not call for special notice; and we dismiss them with the brief allusion to them just made in the preceding paragraph. (See *k*, Fig. 3.)

V. **The Cuneiform Cartilages.**—These are two very small soft pieces, placed one on each side of the larynx, in the fold of mucous membrane which extends from the summit of the arytenoid cartilage at each side to the epiglottis; and, like the other cartilages just considered, are of a conical form. They are placed, however, with their bases upwards, and the apices downwards; that is, in a reverse position to the last described.

They cause the mucous membrane which covers them to project upwards, forming two elevated tubercles, one at each side of the larynx, at the margin of its superior opening, and a little in advance of the *cornicula laryngis*. They call for no further notice.

VI. **The Epiglottis.**—The shape, characteristic appearance, and relative position of this cartilage (named from its place,—Greek, επιγλωττις, "upon, or over the glottis,") will be best understood by reference to Fig. 3.

It is placed at the top of the superior opening of the larynx, ready to close this opening like the lid of a box, whenever its action is required. It is attached by its long narrow end (made still longer by a long fibrous band, termed the *thyro-epiglottic ligament*) to the deep angular depression between the wings of the thyroid cartilage, just below the deep notch that separates the two wings from each other at their upper half. The sides or edges of the epiglottis are—with the exception of a small portion near the broad end, which is not attached to anything—enfolded in mucous membrane, and bound down, as it were, by the membrane, which conceals the edges to a corresponding extent, and, curtain-like, connects the cartilage at each side to the arytenoid cartilages. It is this same membrane that contains and conceals the two cuneiform cartilages, as just pointed out. The upper, or anterior, surface is, in like manner, connected with the base of the tongue, and by this same membrane, a small portion only of the cartilage, and that towards the broad end, being free. In passing to the base of the tongue, the membrane is thrown into three folds, which are named the *glosso-epiglottidean ligaments*, two being *lateral*, and one *median*. Further, a band of elastic tissue, termed the *hyo-epiglottic ligament*, connects the upper surface of the epiglottis to the posterior part of the hyoid bone. The under or posterior surface of the cartilage has no connections whatever, but remains free throughout, and that part of it which, when the cartilage is down, and closing the larynx, corresponds to the opening of the larynx, projects cushion-like *into* this opening; and is hence distinguished by the name of the *cushion*, or *tubercle* of the epiglottis. Further outwards towards the broad free end, the surface becomes concave; and the cartilage is altogether of this contour, from side to side. The consequence of this is that the mouth of the larynx becomes protected, not as with a simple flat lid, but with a cover, the edges of which *over-lap* the orifice, and whose central portion (*the cushion*), as if to make its effectiveness doubly sure, projects in the form of a rounded mass *down within the rim* of the outlet; an arrangement which cannot fail to strike the mind of the thoughtful with many feelings of admiration for the Great Designer's handiwork.

For the epiglottis has a most important and indispensable duty to discharge, a duty of the most vital necessity. It shuts off from the larynx and air-tubes, and directs in another and the proper direction, all improper, or irritating, or injurious matter which, if allowed to pass down within the parts which it has to protect, would prove not only highly obnoxious to the integrity of these parts, but incompatible with life itself. When the epiglottis is not in action, that is, when not down, closing the orifice of the larynx, it stands, sentinel-like, always on the alert, in an elevated position behind the tongue, guarding the opening or door-way to the air-channels, and ready on the briefest notice,—as when anything, which by gaining admission into them, would prove injurious—to fall down upon the outlet, and so to cut off temporarily, and till the danger is past, all communication with it, and therefore with the breathing tubes. The peculiar contour given to the cartilage—its over-lapping edges and the cushion-like mass sinking within the rim of the door-way which leads to the breathing tubes—prevents in a manner the most effectual, as well as the most simple, any solid or liquid matter as it passes from the mouth on its way to the gullet, from finding its way into the breathing organs. When, however, a particle of solid matter—as a crumb of bread, or a drop or two of liquid, as water, &c.—*does* by chance happen to escape the vigilance of the epiglottis, and to find its way into the larynx, a violent paroxysm of coughing, which continues till the offending matter is dislodged and got rid of, is the immediate result. In such cases the crumb of bread, &c., is said, in common language, to have "got down the wrong way."

In structure, the cartilages of the larynx are composed of what is termed *spongy* or *reticulated cartilage*, and of the *true* variety: each kind being possessed of its own distinct properties. The former, for example, has very little tendency to *ossify*, or to become bony; while the latter is, on the contrary, very liable to undergo this change. The cartilages composed of the reticulated variety are:—the epiglottis, the cornicula laryngis, and the cuneiform cartilages. All the remaining cartilages of the larynx belong to the *true* variety, and these, therefore, are frequently discovered to be more or less converted into bone in old or elderly people.

THE HYOID BONE.

From the importance of this bone in serving for the attachment of numerous muscles and ligaments, belonging, in great part, to the tongue and lower jaw, but also, though in a less degree, to the larynx, it is necessary briefly to describe it here.

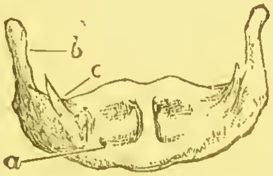


Fig. 4.

The Hyoid Bone.

(*a*) The body; (*b*) The great horn; (*c*) The lesser horn.

The bone is U-shaped, and derives its name from the Greek letter *υ*, and εἶδος ("form"), from its resemblance to that letter. It is situated in the neck just beneath the base of the tongue, and between this and the larynx. From the figure here given, it will be seen to be composed of a *body* and four *horns*—as the projections are termed—two large and two small. On the front external surface the body is rough and irregular, giving insertion to the muscles above alluded to. It is smooth and polished on the inside, where it lies against the *thyro-hyoidean membrane.* When placed in position in the neck, the horns point upwards, as represented in the figure. The smaller pair give attachments to the ligaments termed the *stylo-hyoid*, one to each side.

CHAPTER II.

THE LIGAMENTS OF THE LARYNX.

HAVING in the preceding pages described the cartilages, or separate pieces of the frame-work of the larynx, with their relative positions in the organ, we proceed next to consider how these different pieces are held together, or maintained in the places which they are respectively found to occupy. For, as the separate parts of a complex machine—as a locomotive engine, for example—require, not only to be placed in their allotted positions, but to be also maintained in mutual relationship; so also, with regard to the individual parts of the larynx—as, indeed, of the whole human machine—it is necessary that their relationship, both with regard to one another and to the other parts of the system, should be maintained with due integrity. And this is effected by means of *ligaments*.

The duty of a ligament (from Latin, *ligare*, "to bind") is to bind together two or more separate pieces of the body, as the joints of the finger, for example, or the bones of the leg to the thigh, &c., &c. And, since the frame-work of the larynx is constituted of a number of separate pieces of cartilage, requiring to be held together in certain relationship the one to the other, the presence of ligaments is required here; and these are accordingly found in the organ.

The ligaments of the larynx, not taking into account that already described as covering the epiglottis, may be classified into three groups, namely:—(*A*) The *thyro-hyoid* group,—that is, those which connect the thyroid cartilage with the hyoid bone; (*B*) the *crico-thyroid* group—or those between the cricoid and thyroid cartilages; and (*C*) the *arytenoid* group.

(*A*) **The Thyro-Hyoid Group of Ligaments.**—These consist of two round *lateral* ligaments, and a broad membrane termed the *middle thyro-hyoid ligament* or *membrane.* This latter, which is broad, and somewhat elastic, is inserted into the upper border of the thyroid cartilage throughout its whole extent, exclusive only of the great horns; and passes upwards to be attached to the hyoid bone, at its *inner and upper border*,—an arrangement which enables the larynx, when drawn upwards, to enter, for a limited extent, up within the margin of the hyoid bone, throughout its entire circumference. At the sides, the membrane is thin and wrinkled, and is here pierced for the passage through it of the *superior laryngeal nerve*, and *artery*, of each side. Both its sides are covered by muscle—the *thyro-hyoid.* In front, where it approaches the surface of the neck, and where a little more protection is therefore desirable, from its nearer approach to danger, the membrane becomes much thicker and stronger. At a short distance behind this portion is placed the cartilage of the epiglottis.

The *lateral* portions of the *thyro-hyoid ligaments*, which are possessed of markedly elastic properties, are placed at the posterior boundaries of that last described—one at each side—and ascend from their attachment at the upper or great horns of the thyroid cartilage, to the extremities of the great horns of the hyoid bone.

(*B*) **The Crico-Thyroid Ligaments.**—These are engaged, as their name indicates, in connecting together the cricoid and thyroid cartilages, and consist of a *membranous ligament*, and of a group of others more especially concerned in the union of a number of joints or articulations. The *membranous* ligament, for convenience of description, is usually divided into a *median*, and two *lateral* portions.

The *median portion* is of triangular shape, the apex being uppermost; and, like the *lateral* ligament above described as passing between the thyroid cartilage and the hyoid bone, is possessed of elastic properties. It connects together the contiguous borders of the two cartilages from which it derives its name, passing directly from the one to the other, in front. It is partly covered by the *crico-thyroid muscles.*

The *lateral portions* likewise take their attachment from the cricoid cartilage below, at its upper and inner margin. They are covered on their internal surface by the mucous membrane of the larynx, and have certain deep muscles on their outer surface. The fibres pass upwards and backwards, to become continuous with the lower or true vocal cords at their lower margin, with which they are firmly blended in front.

The ligaments binding together the articulations of the two cartilages are :—*Two ligamentous capsules*, and a *synovial membrane* for each capsule.

The *capsular ligaments* are firmly fixed by one end all round the head of the inferior horns, one for each side, of the thyroid cartilage, and by the other end round the articular facets placed on the sides of the cricoid cartilage ;—thus binding and holding together, and completely surrounding and enclosing, the articulating surfaces ; and permitting, at the same time, a rotary movement to take place between them.

The *synovial membranes* are in like manner placed round each of these joints, but *within* the capsular ligaments. They are concerned in the secretion of an oily fluid, termed *synovia*, the duty of which is to lubricate the articular surfaces, and thus by reducing friction to a minimum, to render the movements of the joints easy and slippery. Another striking example amongst innumerable others found in the economy, of that wonderful design and profound wisdom seen in all the works of the Great Architect.

(*C*) **The Arytenoid Group of Ligaments.**—The arytenoid cartilages are in ligamentous connection,—*below*, with the cricoid cartilage, and *above*, with the *cornicula laryngis ;* in *front*, with the vocal cords, and through these latter, with the *thyroid* cartilages. The *crico-arytenoid ligaments* consist, as in the case of the articulation between the sides of the cricoid cartilage and the tips of the inferior horns of the thyroid cartilage just considered, of fibres completely surrounding and enclosing the articulations between the top of the cricoid cartilage, behind, and the bases of the arytenoid cartilages, above ; and of synovial membrane, one for each joint, placed inside the capsular ligaments, as in case of the group last considered. There is, moreover, a distinct and stronger band of fibres, termed the *posterior crico-arytenoid ligaments*, passing behind each joint, and attached *below*, to the cricoid, and *above*, to the arytenoid cartilage, at the inner and posterior part of the base. The arytenoid cartilages are also in articulation, by means of capsules and synovial membranes, similar in design and action to those just considered, with the cornicula laryngis placed above them.

The ligamentous connection between the arytenoid and the thyroid cartilages is formed by those important bands of tissue which constitute

THE VOCAL CORDS,

Or the strings by the vibration of which the human voice is originated. The cords are four in number, and are arranged in pairs,—two above, termed the FALSE VOCAL CORDS (or the *superior thyro-arytenoid ligaments*), and two below, the *true vocal cords* (or the *inferior thyro-arytenoid ligaments*). The former, which when compared with the latter, are—so far as the production of sound is concerned—of but comparatively slight importance, consist of a few slight bands of fibrous tissue, covered by folds of mucous membrane, stretching across the interior of the larynx, one end of each being fixed, *anteriorly*, in a depression between the wings of the thyroid cartilages, rather above its middle, and close to the attachment of the epiglottis; the other end, *posteriorly*, to a rough elevation on the front surface of the arytenoid cartilages. THE TRUE VOCAL CORDS are those two important bands of tissue, without which vocal language would have no existence, no place in the world. On these two little and insignificant-looking strings depend many of the blessings of life:—such as the charms of vocal music, the numerous delights and untold benefits of social intercourse, &c. Without them, the telling words and impassioned language of a master orator, who, may be, thrills our whole soul with multitudinous emotions,—such as joy, fear, sorrow, religious or political fervour, love, hate, &c.:—as also the lightning-like contact of mind with mind, the passage of sparks of wit between man and man, the edifying and mind-polishing effects of rational and thoughtful conversation (one of the greatest pleasures of society),—all these would be without existence in the world. And hence one of the greatest powers now possessed and exercised by man upon the mind of man would be annihilated; and man would, in many respects, be on a level with the brute creation. The darkness falling on the mind would, like the three days of Egyptian darkness, be one to be felt. In short, human life, now that we have tasted of the sweets of vocal intercourse, would be so comparatively dull, tame, and blank, that any efforts to describe it, even faintly, would be sheer mockery.

The true vocal cords are attached each by one end, —*in front* to the thyroid cartilage, a little below the insertion of the false vocal cords, or about half way down between the central notch, and the lower border; and by the other end *posteriorly*, to the elongated anterior process or projection, at the base of the arytenoid cartilage. The space between, or that bounded by the two cords, is termed the *glottis*, or *rima glottidis*.

In structure, the true vocal cords are composed of elastic fibrous tissue, placed within the lips of the glottis, the fibres having a closely parallel arrangement, and constituting a band of considerable strength. The cords are covered by *mucous membrane* (like that coating the inside of the lips of the mouth), and is so thin in this situation, and so closely adherent to the cords, that the latter may be seen shining through it, sharp and straight.

The length of the true vocal cords in a full grown man, is about seven lines, and in the female, about five.

CHAPTER III.

THE INTERIOR OF THE LARYNX AS SEEN IN SECTION.

HITHERTO we have been engaged in considering the constituent parts of the frame-work of the larynx, and of the structures (the ligaments) which bind together and keep in proper relationship to one another, the individual cartilages entering into its formation. Let us now view the larynx as a whole, and as seen in section with the structures hitherto considered, all in their proper place.

The interior or cavity of the larynx is divided into two compartments, an upper, and a lower, by the *rima glottidis*, a narrow chink, and when viewed in longitudinal section, it presents the appearance of two funnels meeting together by their narrow ends, from opposite directions (see Fig. 5).

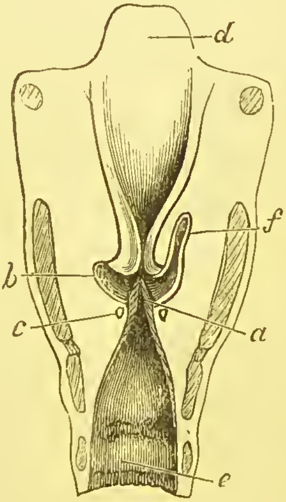


FIG. 5.

THE INTERIOR OF THE LARYNX, AS SEEN IN LONGITUDINAL SECTION FROM BEHIND.

(*a*) The RIMA GLOTTIDIS; (*b*) The VENTRICLE, of one side; (*c*) The TRUE VOCAL CORD, of one side; (*d*) EPIGLOTTIS; (*e*) Commencement of the TRACHEA or Windpipe; (*f*) LARYNGEAL POUCH of one side. The section on this side has been carried further forward in order to show the Pouch.

In the upper compartment are:—Two recesses termed the *ventricles* (*b*), situated immediately above the *rima glottidis;* and, leading from these, are the *pouches*, or *sinuses of the larynx.* Here also, are situated the *false vocal cords.* The termination of this compartment at the top is termed the *superior aperture of the larynx*, which opens directly into the *pharynx*, or cavity at the top of the gullet. The lower compartment gradually widens until it passes into, and becomes continuous with, the *trachea*, or main wind-pipe.

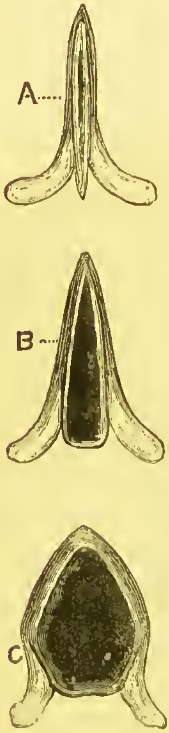


FIG. 6.
THE GLOTTIS, as it appears,—(*A*) Nearly closed; (*B*) As in ordinary tranquil respiration; (*C*) When open to its widest extent.

These several parts of the larynx we will now dwell upon a little more in detail.

I. The *rima glottidis* (or simply the *glottis*). This, as will be seen by reference to Fig. 5, *a*, is not a *structure*, but the narrow chink or space formed by the separated and sharply defined edges of the true vocal cords; being bounded behind by the bases of the arytenoid cartilages, to which, as will be remembered, the posterior ends of the cords are attached. The glottis varies in size and form according to circumstances; being, when nearly closed, merely a long narrow chink, as seen at *A*, Fig. 6. When moderately open, as in ordinary tranquil respiration, it is a long triangular opening, with the apex to the front, and the base stretching between the arytenoid cartilages, *B*, Fig. 6; and when opened to its widest extent, the figure assumed is that of a lozenge, as represented at *C*, Fig. 6. The glottis is the narrowest part of the interior of the larynx, being not more than three or four lines across at its widest part, though dilatable to about half-an-inch. Its length from before backwards in the adult male, is about eleven lines; but in females, and in males before puberty, its length is not more than about eight lines, and from side to side about two lines.

II. The *ventricles of the larynx.* These are hollows or recesses, and are situated immediately above the glottis, being bounded below by this fissure. The superior boundary is formed by the false vocal cords, and thus the ventricles are situated wholly between the two pairs of vocal cords.

They consist of two cavities, narrowest at the entrance, in the sides of the larynx, one at each side, *b*, Fig. 5; and in the position above named. The floor of each, which is straight, is formed by the projection inwards towards each other, of the mucous membrane covering the true vocal cords—that is, by the structures which by their approximation, form the fissure termed the glottis. The roof, or upper boundary, is rounded off into a circular form, the anterior part of which is continuous, outwards and upwards, with the inner wall of the laryngeal pouches.

III. The *laryngeal pouches.* These hollows or cavities are the continuations of the ventricles upwards, from the outer and front boundaries of the ventricles. They form *culs-de-sac*, one at each side, of about half-an-inch in length, between the thyroid cartilage, externally, and the false vocal cords, internally, the top of each being nearly on a level with the upper border of this cartilage, and by the side of the lower parts of the epiglottis (see Fig. 5, *f*).

The general shape of each pouch is concave, besides which, it bends a little in a backward direction. The interior has opening upon its surface, the mouths from a number (sixty or more) of mucous glands; the secretion from which serves to lubricate the membrane, and keep it in a moist condition. They are surrounded by a layer of fat; externally to which is a fibrous investment, which is continuous with the false vocal cords. At the outer side also, and over the top of each pouch, is placed a number of muscular fibres, whose purpose is apparently to compress or squeeze together the sides of the sac as occasion may require. Moreover, there is an abundant supply of nerve branches (from the *superior laryngeal nerve*) distributed to each pouch.

IV. The *superior aperture of the larynx.* This is the somewhat triangular orifice by which the larynx (and through this, the air-passages) communicates with the pharynx. The widest part of the opening is in front; the narrowest, behind. The margin looks backwards and downwards. The epiglottis bounds the aperture in front; the apices of the arytenoid cartilages, and cornicula laryngis, behind, with that portion, also, of course, of the mucous membrane which joins them; and the *aryteno-epiglottidean* folds of mucous membrane at the sides,—that is, those folds or curtains which pass from the apices of the arytenoid cartilages and cornicula laryngis, to the sides of the epiglottis.

CHAPTER IV.

APPEARANCES PRESENTED BY THE LIVING LARYNX ON LOOKING DOWN WITHIN IT, FROM THE BACK OF THE MOUTH.

IN order to see down within the living larynx it is necessary to have recourse to artificial means, by which a sufficient amount of light may be thrown upon the organ from the back of the mouth; and the parts thus illuminated, reflected from the surface of the contrivance, to the eye of the observer. The instrument designed for this purpose is termed the LARYNGOSCOPE; the most common kind of which consists of two mirrors. One of the mirrors is of small size, is fixed to a slender shank, and the end next the mirror is bent to an angle with the stem of about 120°. It is of sufficient length to admit of being conveniently

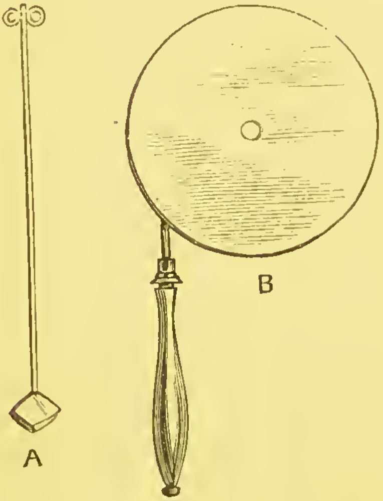


FIG. 7.
THE LARYNGOSCOPE.
(*A*) The small mirror; (*B*) The large mirror.

held by the observer in position at the top of the throat. The second mirror is much larger, is somewhat concave, and is used for throwing a strong light upon the small mirror. It has, generally, a hole pierced through its centre, through which the eye may look upon the small mirror when in position.

When the instrument is to be used, the person to be examined sits with the light,—a good, steady, bright flame,—on a level with his eyes, and placed a little behind them, the head being thrown slightly backwards. The observer, sitting or standing opposite, as most convenient, carefully and cautiously places the small mirror, previously a little warmed, at the back of the mouth, where it is elevated or depressed, and otherwise so manipulated as to throw down the light reflected from the large mirror, upon the larynx, where the parts come into view by being depicted upon the small mirror. The large mirror may be held in the hand, being provided with a handle for the purpose; or fixed to the forehead by means of an elastic band passing round the head, or placed over the eye nearest the light by a spectacle frame. In both the latter cases the hands of the observer are free and unembarrassed,—an arrangement which is often found to be highly convenient.

The parts as thus seen appear to the eye in reverse order as regards the antero-posterior aspect,—that is, those parts which are in reality nearest to the observer, appear in the mirror to be the most distant, and *vice versa.* When a good image of the larynx is obtained, the following appearances are conveyed to the eye:—

On each side of the superior aperture appear two elevated portions (*a*, Fig. 8), caused respectively by the cornicula laryngis, and the cuneiform cartilages. In front is seen the tubercle or cushion of the epiglottis (*b*), and behind, the mucous membrane joining the arytenoid cartilages, which membrane may be seen doubled together, — as when the cartilages are closely approximated,— or more or less stretched, according to the extent to which they are separated (*d*, *d*, *d*, Fig. 8). On looking down through the superior orifice, the *rima glottidis* comes into view. And this may be seen either as a narrow chink running from before backwards,—as happens during the evolution of a high note in music (*A*, Fig. 8); or more or less widely separated according to the character of the respiration, &c., being widest during a very deep inspiration (*B* and *C*, Fig. 8).

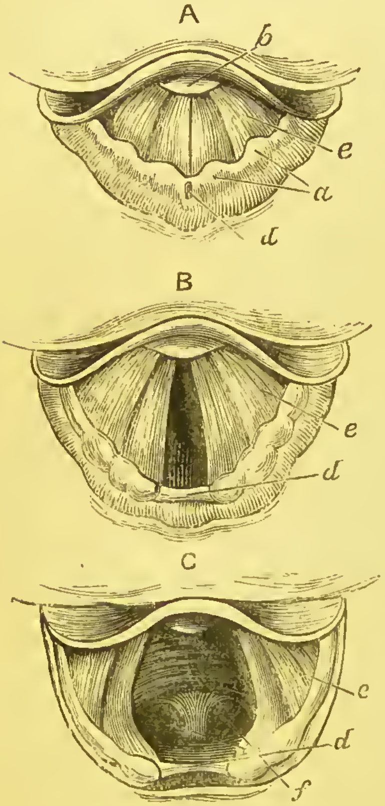


Fig. 8.

Laryngoscopic Views of the Glottis.

(*A*) As seen when nearly closed; (*B*) Partly open; (*C*) As wide open as possible.

As the margins of the glottis are formed by the true vocal cords, and as these are attached to the anterior processes of the bases of the arytenoid cartilages, passing thence directly across to the front of the larynx, we know that the part now being examined (the glottis) must correspond with a point about half-an-inch below the most prominent part of the *Pomum Adami*, on the outside. The position of the false vocal cords (*e*, *e*, *e*, Fig. 8) may be seen a little above the glottis; showing as a pair of projecting folds of mucous membrane, which do not approach the middle line so nearly as do those immediately below,—that is, as do the *true* vocal cords. The false cords are arched in contour, and are, moreover, much thinner and weaker than the pair below them.

Immediately above the kind of platform formed by the glottis, and beneath the upper cords, are also seen the two deep oval depressions, one at each side,—the *ventricles* of the larynx. And when the glottis is very widely open, the upper part of the trachea, or wind-pipe, can likewise be plainly seen; and even its bifurcation, still further down, into the two main *bronchi*, or the chief air-tube of each lung, as seen at *f*, Fig. 8, *C*.

It may be here remarked that the laryngoscope is not a mere toy, invented solely to gratify an excited curiosity, or to afford amusement by looking down people's throats. On the contrary, it is an instrument of a highly practical kind; enabling the physician to examine the parts above enumerated, *with his eye*, and thus to be better able to form an opinion, or to correct or confirm a supposition he may have already entertained, as to the nature and exact seat of the disease or abnormality, under which the patient may be suffering. And indeed, to ascertain *by ocular inspection* whether disease is present at all in the suspected part. The advantages thus obtained will be readily seen to be highly estimated by the physician, &c.; as the precise spot implicated, is, when thus brought into sight, not only certainly known, but the remedy, if thought desirable, may be directly applied to the diseased part, and also with almost the same precision as to a diseased structure situated on the external surface of the body. There is no groping in the dark, no uncertainty as to whether one or more than one particular part within the dark interior of the larynx be the seat of disease. And no doubtful question in the mind of the operator as to whether or not he be applying the remedy to the right place; for he has now his eye to guide him in his delicate manipulations.

CHAPTER V.

THE MUSCLES OF THE LARYNX.

As the different parts of which the larynx is composed, are designed to be moveable and to change their position both as regards one another, and the adjacent structures—or, the larynx considered as a whole; it is necessary that it be provided with means whereby this end may be accomplished. That is, it must be provided with *muscles;* and these we now proceed to discuss:—

The function of a muscle, wherever situated, is that of *contraction;* its power, namely, of shortening itself, and thus drawing nearer together its two extremities, with the consequent tendency to bring into closer approximation the two parts into which its ends or tendons are affixed. The function of a muscle is *active.* It is always tending to destroy the relationship of the parts to which it is attached. And it thus differs entirely from the function of a ligament, whose action we have seen to be *passive*, or that of binding together and *preserving* within certain defined limits, the structures with which it is in connection,—*preserving* and *maintaining* the relationship of these one with another.

Certain of the laryngeal muscles are termed *intrin-*

sic muscles, and others *extrinsic* muscles. The former are exclusively concerned in the movements of the *individual* pieces of the larynx; and are situated wholly within, or upon, the individual portions, being placed in the places which they are found to occupy, for the purpose of being exclusively devoted to the movement of the cartilages upon which they are specially fixed. On the contrary, the extrinsic muscles are attached *by one end only* to some part of the larynx; and by the other end to some *neighbouring* part,—an arrangement which allows them to exert their action upon this part also, and so to fulfil a two-fold duty.

But, besides these two sets of muscles, there are others which act upon the larynx in an indirect manner only, owing to their being attached not directly to the larynx, but to some other part, this latter only having direct muscular connection with it. As in the case of the *sterno-hyoid* muscle for example, whose only motor action upon the larynx is through the medium of the hyoid bone, this being connected with the larynx by the *thyro-hyoid muscles*.

The names of the *intrinsic* muscles of the larynx are as follow. All of them, except the *arytenoid*, occur in pairs, and their names at once suggest the respective parts to which they are attached:—

The crico-thyroid (two).
The crico-arytenoid (*posterior* and *lateral*).
The thyro-arytenoid (two).
The arytenoid (one).
The aryteno-epiglottidean (two).

The *extrinsic* muscles of the larynx are :—

The sterno-thyroid (two).
The thyro-hyoid (two).
The constrictors of the pharynx (*middle* and *inferior*).
The sterno-hyoid (two).
The omo-hyoid (two).
The muscles of the "supra-hyoid region."

(*A*) THE INTRINSIC MUSCLES OF THE LARYNX.

I. **The Crico-Thyroid Muscle.**—This is a short and thick triangular muscle, fixed on the outside of the cartilages whose names it bears, one to each side of the larynx. The apex is attached to the side and front of the cricoid cartilage in a direction downwards and forwards; the broad base spreads, fan-like, upwards and backwards to be attached to the lateral lower border of the thyroid cartilage, and to the anterior border of its lower horn—as seen in the marginal figure (Fig. 9). The lower portion of the muscle, the fibres of which pass in a nearly horizontal direction to the inferior horn of the thyroid cartilage, are generally arranged into a band or bundle by them-

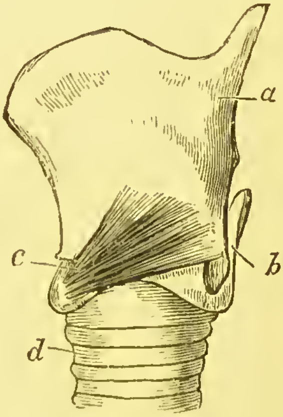


Fig. 9.

View of Left Crico-Thyroid Muscle.

(*a*) The thyroid cartilage; (*b*) The cricoid cartilage; (*c*) The crico-thyroid muscle; (*d*) Commencement of wind-pipe.

selves, by virtue of which arrangement they can exert their action upon the lower horn independently of the rest of the muscle.

The two crico-thyroid muscles do not meet together in front of the cricoid cartilage, but are separated by the triangular *crico-thyroid membrane*, as indicated by *c*, Fig. 9.

The effect of the action of the muscle is, as will readily be apparent from a slight consideration of its attachments, and of the point of articulation or pivot upon which the thyroid cartilage moves upon the cricoid, to approximate the lower and front parts of the thyroid to the upper and front parts of the cricoid cartilage. And, as the arytenoid cartilages are articulated with the cricoid at a much higher level than the axis on which the thyroid rotates on the cricoid, the distance between the fore part of the thyroid and the arytenoid cartilages becomes augmented, *with a consequent and corresponding tension of the vocal cords*,—these latter passing, it will be remembered, from the fore part of the arytenoid to the thyroid cartilages. In short, the action of the crico-thyroid muscle *increases the tension of the vocal cords.* In this respect, therefore, it exerts an action upon the vocal cords similar to what the regulating screws attached to the violin, the harp, &c., exert upon the strings of these instruments. And the *effect* is likewise the same,—namely, the raising of the tone or pitch to a higher level. The action of the muscle, and the manner in which it increases the tension of the vocal cords, will be rendered more apparent by consulting the accompanying diagram, Fig. 10, in which the different parts are shown in section, the left half of the larynx having been cut away.

When, then, the muscle is in a state of quiescence, the thyroid cartilage remains as represented by the unbroken outline of the figure; but, when the muscle contracts, the cartilage is made to fall forwards, as seen in the dotted outline, dragging down with it the attached ends of the vocal cords; while, in this latter position, the distance between the front of the thyroid and the arytenoid cartilages is seen to have become increased, and the vocal cords, owing to their posterior attachment not partaking of this forward movement, become stretched, or rather *tightened*, to a corresponding degree.

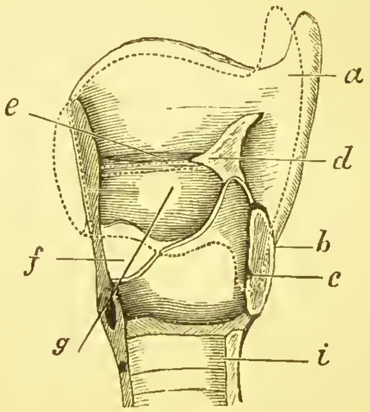


Fig. 10.

Showing the Action of the Crico-Thyroid Muscle.

(*a*) The thyroid cartilage; (*b*) The cricoid cartilage; (*c*) Point on which the thyroid moves upon the cricoid; (*d*) The arytenoid cartilage; (*e*) The true vocal cords; (*f*, *g*) Line of traction of the crico-thyroid muscle; (*i*) The wind-pipe.

This movement of the thyroid cartilage may readily be made perceptible to the reader's senses by his placing the tip of his finger on the most prominent part of the cartilage of his own neck,—that is, on the *Pomum Adami*,—or on that of a friend's, when, by raising or lowering the pitch of his voice, depression or elevation of the cartilage will respectively result, and be felt by the finger. The principal line of traction of the crico-thyroid muscle is represented by the line *f*, *g*, Fig. 10.

II. The Posterior Crico-Arytenoid Muscle (*d*, *d*, Fig. 11, page 42).—This is mainly situated on the posterior aspect of the larynx—one at each side. It is attached behind, to the whole breadth of the posterior surface of the cricoid cartilage; and the fibres converging thence in an upward and outward direction, are inserted into the base of the corresponding arytenoid cartilage, at its outer angle, behind the insertion of the *lateral* crico-arytenoid muscle.

This muscle likewise acts upon the true vocal cords, but in a different manner from the last named. It draws the outer angle of the arytenoid cartilage, at each side, *backwards*, towards the posterior middle line of the cricoid,—a movement which causes the former cartilage to revolve on its axis, at the top of the latter cartilage. But since the true vocal cords are, as will be remembered, attached to the anterior angle of the arytenoid cartilages, the rotation of these, separates the vocal cords to a greater or less extent from each other; and widens the glottis, of course, to the same extent.

III. The Lateral Crico-Arytenoid Muscle.—This,—one for each side—takes origin from the upper border of the side of the cricoid cartilage; and passing in an oblique direction backwards and upwards, is inserted by its other end into the arytenoid cartilage, at a point in front of the muscle just described; some of its fibres passing a little beyond the external process of the base, to be fixed into the anterior surface of the cartilage.

The muscle acts as an *opponent* to the muscle just described,—that is, it causes the vocal cords to approximate to each other, and so to *narrow* the glottis.

IV. **The Thyro-Arytenoid Muscle**—one to each side—is situated above the preceding muscle, and consists of a series of muscular bands, passing from the front and internal surface of the thyroid cartilage, near the angle formed by the two wings, and at its lower two-thirds, to the base of the arytenoid cartilage; the lower band of fibres being inserted into the anterior process of the base of that cartilage, and to the adjacent surface,—that is, into the same angle that gives attachment to the posterior extremity of the vocal cord of each side.

This muscle is an important and particular support to the vocal cord of the side to which it belongs,—its fibres lying parallel to the latter, on its outer side, within the folds of the *rima glottidis*,—some of the fibres, indeed, being *intimately connected with the cord*, by being affixed to its outer surface or border. It is antagonistic in its action, to the crico-thyroid muscle. For, while the effect of the latter is, as we have seen, *to depress* the thyroid cartilage in front, and thus to *tighten* the vocal cords; that of the thyro-arytenoid muscle is *to raise* the thyroid cartilage, and thus *to decrease* the tension. The upper thin parts of the muscle, however, tend rather *to depress* the arytenoid cartilages,—that is, to cause them to fall forwards. The annexed figure (Fig. 11) shows by the letter (*a*) the muscle of the left side, and its intimate connection with the vocal cord of its own side of the larynx. The muscle of the right side is not shown.

V. and VI. **The Arytenoid, and the Aryteno-Epiglottidean Muscles.**—These, from their intimate union with one another, are best described together. There is one only of the former, but two of the latter. The *arytenoid muscle* (*f*, Fig. 11) is a thick band, passing directly across from the posterior surface of one arytenoid cartilage to the other; its fibres being inserted into the whole extent of that surface, in both the cartilages. The *aryteno-epiglottidean muscles* appear on the surface of the former as two oblique bands, crossing each other in the middle line, each being attached by one end to the lower and outer angle of its corresponding arytenoid cartilage; from which it passes upwards and outwards,—sending muscular fasciculi as it advances, to the subjacent arytenoid

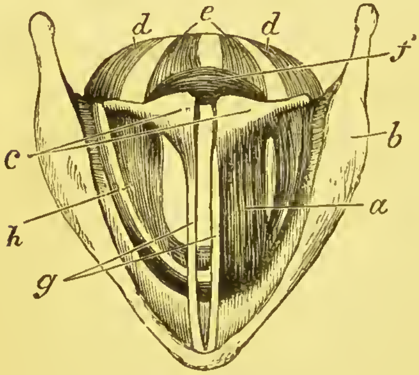


FIG. 11.
VIEW OF THE DISSECTED LARYNX, as seen from above.

(*a*) The thyro-arytenoid muscle of left side; (*b*) The thyroid cartilage; (*c*) The arytenoid cartilages; (*d*, *d*) The posterior crico-arytenoid muscles; (*e*) Posterior crico-arytenoid ligaments; (*f*) The arytenoid muscle; (*g*) The true vocal cords; (*h*) Right lateral crico-arytenoid muscle.

muscle,—and crossing its partner of the opposite side to become inserted into the upper and outer portion of the arytenoid cartilage, and into the corresponding aryteno-epiglottidean fold of mucous membrane.

The arytenoid muscle draws the arytenoid cartilages more or less towards each other; and when the muscle is in full action—when it is exerted to its full power—it likewise *depresses* these bodies. The aryteno-epiglottidean muscles have, from the manner in which they grasp the arytenoid cartilages while passing over these, and from their close muscular union with the arytenoid muscle, a similar action to the arytenoid muscle; that is, they depress and approximate the arytenoid cartilages. They also draw down the epiglottis; and this combined movement results in the contraction of the whole of the superior aperture of the larynx. In the marginal figure (Fig. 12) is given a posterior view of the dissected larynx, in which the muscles just described are shown.

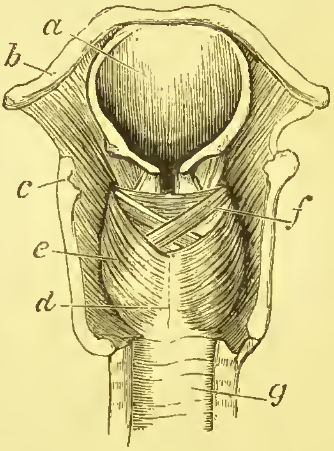


Fig. 12.

The Dissected Larynx, as seen from behind.

(*a*) The epiglottis; (*b*) The hyoid bone; (*c*) Posterior border of thyroid cartilage; (*d*) Ridge in middle of cricoid cartilage; (*e*) Left posterior crico-arytenoid muscle; (*f*) One of the oblique bands of the aryteno-epiglottidean muscle; (*g*) The wind-pipe.

To recapitulate briefly what has been advanced regarding the actions of the foregoing group of muscles,—the *intrinsic* group, namely,—we see *firstly*, that the true vocal cords, in order to be able to evolve a varying pitch of sound, require to be modified in tension,—just in the same way as do the strings of the violin, harp, &c.; and this is done by the crico-thyroid muscle, which pulls down the arytenoid cartilage, *in front*, towards the front rim of the cricoid cartilage, as shown in Fig. 10. *Secondly*, that this movement having been effected, and when it becomes necessary after the relaxation of the crico-thyroid muscle, to restore the thyroid cartilage to its previous position, this is accomplished by the action of the thyro-arytenoid muscles, Fig. 11. *Thirdly*, that the vocal cords require occasionally to be more or less separated from each other, as during a deep inspiration, &c.; and this act is accomplished by the posterior crico-arytenoid muscles. *Fourthly*, that when the cords are to be restored, according to requirements, more or less to their original degree of approximation, these latter muscles relax, and the restoration and approximation is effected by the *lateral* crico-arytenoid muscles. The comparative width of the glottis,—that is, the distance from each other of the vocal cords,—does not affect the *pitch* of the voice. *The pitch of the cords is the result of their tension alone;* and so long as this tension is preserved, or remains unmodified, so long will the pitch remain the same, however wide or narrow the glottis may be. There is, however, a marked difference in the degree of *force* required to evolve the same note; the power needful increasing according to the extent of the separation of the cords from each other, and *vice versa.* And *fifthly*, that the superior aperture of the larynx is contracted in dimensions by the action of the arytenoid, and the aryteno-epiglottidean muscles;—these last named, drawing down the epiglottis, also render the notes produced, of a deeper tone, and of a duller sound.

One cause, then, of the difference in the range of voice between one person and another, consists—other things being equal—in the greater power possessed by one person over another *in making more tense his or her vocal cords;* for the tighter these are strung, the higher is the resulting note. But as in different persons, there are differences in the *length* and in the *thickness* of the vocal cords, just as there are differences in the length of people's limbs, so are there differences in the amount or degree of force *required* by different individuals to produce the same note; and even though the same *absolute* degree of contractile force be in operation in all the cases. In other words, the *longer* the cords, the greater the tension required to evolve any particular note; and the *thicker* the cords, the greater the force required to produce any particular note. We have, therefore, in the above conditions one explanation, at least, of the differences in the natural pitch of the voice, as observed in nearly all the different persons we come across; and an explanation, also, of the difference in range of voice between one person and another. For, though much can be done, and it is astonishing how much has been done by practice, and careful cultivation of the voice (the exercise of the laryngeal muscles resulting in their increased strength), yet no amount of training could produce the difference met with in the character, for example, of a fine Alto voice, and a deep Basso; nor could any amount of training or cultivation satisfactorily change the one into the other.

Another factor in the difference of vocal power of different persons, consists in the *difference of resonance* of their respective vocal cords; and of the cartilages and adjacent structures of the larynx. And this difference in the resonance of these parts constitutes, I believe, [the presiding condition which determines the superiority in musical character of one voice over that of another. Where the structures named, are lax and puffy, and devoid of proper tone, we cannot expect to find, nor do we find, that purity, sweetness, and strength of the vocal powers which are met with in those whose vocal organs, and all in connection with these organs, are finely strung, and possessed of superior tonicity. For it is this healthy tonicity which confers upon the tissues, not only the property of responding to the calls made upon them, but of responding with due alacrity; and which also confers upon them their delicate elastic properties.

In women—and in boys, before the age of puberty—the length of the vocal cords, as compared with men, is as 2 : 3. But in boys at the age of puberty, the larynx begins to increase rapidly in size, like the rest of his organisation; and the vocal cords, partaking of this increase, finally attain their maximum length, as the boy develops into full manhood. And this lengthening of the cords produces a difference in the character of the voice: this becoming changed into one of a deeper or lower pitch, corresponding to the addition made to the length of the cords, and to their increased thickness.

A remarkable property possessed by the larynx is its power of *preserving the same pitch*, or sounding the same note, however forcibly or loudly that note may be sounded ;—the loudness of the note being limited only by the power possessed by the vocalist, of expelling air through the larynx from his lungs. He may begin, for example, in *pianissimo*, and with a note so soft as scarcely to be audible, and end in *fortissimo*, in a tone so loud that the very room appears to partake of the vibration of his chest-walls; and yet the note sounded *shall be of the same pitch throughout.* But in a wind instrument of man's invention, this power of increasing the loudness of the note is confined within comparatively narrow limits. In the latter, when the air passing through the pipe—as in case of the flute, fife, &c.—attains a certain velocity in sounding any particular note, any further attempts to increase the intensity of the note, by a still more vigorous blow or stream of air, proves at once abortive, by the note jumping an octave higher. In the larynx, however, provision is made whereby the note or tone originally beginning in *pianissimo*, may be rendered louder and louder, and still preserve its pitch, however forcibly the air may be passed through the larynx from the lungs—a result unattainable by any *artificial* contrivance. And though the exact mechanism by which this admirable property or power of adjustment is accomplished by the larynx, is not fully known or made clear, we may safely infer that it can be achieved only by the simultaneous and proportionate relaxation of the vocal cords, by the action of the thyro-arytenoid muscle; the delicacy of which adjustment is so fine that the mind cannot grasp it.

During the vibration of the vocal cords these do not strike against the lateral walls of the larynx: such a circumstance, indeed, would be fatal to their sonorous action or resonance, and the resulting note, if a note were possible, would be dull and dead. Provision is therefore made by which any amount or degree of vibration may take place without the danger of such a circumstance happening, in the existence of special excavations in the sides of the larynx, immediately above the vocal cords. And these excavations are the *ventricles of the larynx*, already described at page 27. The representative in brass wind instruments of these excavations is the bell-like expansion of the mouthpiece, to allow room for the vibration of the lips.

CHAPTER VI.

THE LARYNX A REED INSTRUMENT.

WE have said in a former place (*Introduction*, page 1) that we may look upon the contrivance by which the human voice is produced as "consisting merely of two strings, placed on the inside of a tube, these strings being vibrated, and the resulting sounds produced by the passage over them of a stream of air." But to what particular class of wind instrument does the larynx belong? Can the vocal cords be classed with musical strings, the cords simply obeying the laws of such strings? Or is the vocal apparatus a reeded instrument; the cords, with their enclosing plates of mucous membrane, acting the part of the tongue in such instruments? Or again, is the sound—as regarded by the ancients—the result of a mere molecular vibration of the air, produced by its passage through the chink of the glottis? And lastly, does the organ of voice combine within itself *all* these different sources of sound, and act partly as a stringed instrument, as a tongued or reeded instrument, and as a simple wind instrument?

We cannot accept the view entertained by the ancients upon this question, as we should have to discard the evidence obtained by direct experiment that the larynx *is* the real seat of the sounds evolved,

—the rest of the tube having comparatively little to do with the vibrations.

The other questions we may briefly answer by the statement, that the most prevalent opinion of the present day favours the second of these queries, namely, that the larynx is a wind instrument of the *reeded* variety, with a double membranous tongue ; this double tongue being constituted by the two lips of the glottis. As the air passes upwards from the chest, these lips are thrown into vibration by the impulse of the air against them ; and the resulting sound is then conveyed, variously modified, through the external air-passages,—but still with the undulatory motion communicated to it by the vibration of the lips of the glottis. In such an instrument it becomes necessary, in order that the sound generated may be of a pure quality—in other words, in order that the sound produced by the two tongues may be in unison—that the tissues composing them should be of equal breadth and weight, and be subject to the same tension : otherwise, a range of musical tones would result. They must, further, lie parallel to each other, and also lie in the same plane as each other ; or no sound will be produced. For this purpose it is necessary, as will readily be seen, that the tissues composing the vibrating media should be, not only exactly matched—that one should be the exact counterpart of the other—but that the forces which govern their movements, so as to preserve their parallelism—their tension, &c.—should be equal ; and moreover, that these forces should act together as one individual entity, and not one after or before another. How wonderful, then, is the harmony which is found to exist between the minute muscles of the larynx! For we have seen that these muscles occur in pairs—one to move one side of the laryngeal cartilages, and its companion the other. And how exactly matched, too, must be the *sizes* of the opposite cartilages to which these minute muscles are attached! And how nicely balanced their freedom of movement upon their articulating surfaces! For if the leverage obtained by the muscle of one side be greater or less than that commanded by its fellow muscle—as would result if one cartilage, or point of attachment, were larger than the corresponding cartilage;—or again, if the moving force for one side required to be greater than for the other, in consequence of defective mobility of the articulations of one side, then would unison be immediately destroyed—if, indeed, the voice could be produced at all; and discord and inharmonious clashing would be the inevitable result. We are, indeed, "Fearfully and wonderfully made." It is estimated that for the production of the most simple tones and modulations of the voice, more than one hundred muscles are called into action at one and the same time; and yet there is found no jarring or irregularity in time of action in the whole number, greatly, too, as these muscles vary in size and in their situation in the body!

It is but right, however, to state that there are many advocates in favour of the theory that the vocal cords act as *musical strings*, and not as a reeded instrument. For there is found, they say, and say truly, a perfect agreement between the action of the vocal cords and vibrating strings,—the strings, in case of the larynx, being vibrated, not by direct mechanical touch from a solid body, but by the momentum of air coming from the chest. The vocal cords do certainly obey closely the ordinary principles to which musical strings are subject, and especially if allowance be made for the peculiarities of elastic animal substances, with regard to their elasticity, &c. Mr. Bishop, who appears to have given deep and conscientious study to this question, says: "Since the vocal cords have been proved to extend and contract for acute and grave sounds, respectively, and after death to vibrate in a great measure like musical strings, we think it may be fairly inferred that they likewise obey, to a certain extent, during life, the laws of the vibration of such strings." Again: "It is found by experiment, that by artificially dividing their length into two neutral segments, there results the octave of the fundamental note, which proves that at all events they vibrate as cords."

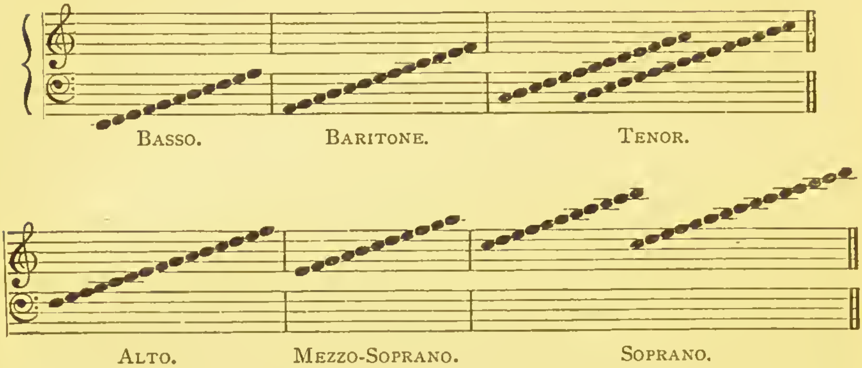
For my own part, the view which most commends itself to my mind is the conclusion to which Mr. Bishop has himself finally come,—when he says that the vocal apparatus is "influenced by the air expelled from the chest, in precisely the same way as if it were a stretched cord, a reed, or a vibrating tube." And that "the vocal organs do, in fact, combine the properties of these various instruments, and are thus the perfect types of which these instruments are only imperfect imitations."

CHAPTER VII.

COMPASS OF THE VOICE, FALSETTO, &c.

IN singing, the compass of the voice extends through two or three octaves; and taking the male and female voices, it will reach four octaves. The lowest note of the female is an octave higher than the lowest note of the male; and the highest of the female is an octave higher than the highest of the male.

Both the male and female voice is of two kinds —the *Bass* and the *Tenor* for the male, and the *Contralto* and the *Soprano* for the female;—the difference between the respective pairs consisting not in their difference of *pitch*, but in the particular part of the scale in which the chief strength of the voice lies; the bass being strongest in the lower notes, the tenor in the upper, for the male; and the contralto strongest in the lower, and the soprano in the higher notes, for the female. The chief difference, however, between these various kinds of voice is that of *quality* or *timbre*. Besides the four varieties named, there are two intermediary kinds of voice—one for each sex; namely, the *Baritone* for the male, and the *Mezzo-Soprano* for the female. The former lies between the bass and tenor, and the latter between the contralto and the soprano. Subjoined is shown the usual compass of these respective kinds of voice :—



The difference in pitch between the male and female voice depends upon the difference in length of their respective vocal cords, these being nearly as 7 : 5. In boys, before the age of puberty, the length of the vocal cords is within a fraction of that of the female or as 6¼ : 7 ; and there is little difference, therefore, as regards the pitch between boys of twelve or fourteen years old and the female.

The difference in *quality* or *timbre* between the voices of the male and female depends upon the marked difference that is found to exist between the walls of their respective vocal organs ; those of the male being much more expanded than the females, besides presenting certain other differences. Sometimes the cause of the difference is not easy to make out ; and more especially is this the case between the *tenor* and *bass*, or *soprano* and *contralto*. We may, however, as Müller has observed, " form an idea of the cause of these differences of timbre from recollecting that musical instruments made of different materials, as metallic and gut strings; metallic, wooden, and membranous tongues; metallic, wooden, and paper pipes, or flutes, may be tuned to the same note, but that each will give it with a peculiar quality or timbre."

If we consider, also, that every individual person we meet has a different speaking voice—one quite peculiar to himself, arising both from natural inheritance and numberless modifying after causes—such as those connected with the mode of life, the character of the occupation, the influence of disease, the manner of the person's up-bringing, the difference in domestic and personal habits and ways, the difference in the character of the locality or climate in which the individual has long resided, and such like influences—we shall be at no loss to account for the differences observed in the singing voice, not merely in pitch, but in quality. .

The Strength of the Voice depends upon many circumstances, such as the capability for resonance of the various parts concerned in vocalisation—the degree or extent to which the cords themselves are capable of vibration—the capacity of the chest (vital capacity), the effects of changes of temperature, the degree of humidity of the atmosphere, &c. It is said of Grassini that by changing her residence from the pure genial air of Italy to the humid and highly changeable atmosphere of our English climate, her voice not only became less bright and clear, but that it lost as much as an octave in pitch.

Over-fatigue of the muscles of the larynx, as by excessive and prolonged talking, public speaking, singing, shouting, &c., is a common cause of voice weakness. It is not so much the *exercise* of the muscles, as the length of time they are *continuously* under it, that produces the mischief. The strength of a horse becomes best developed, not by putting the animal to a work of one unvarying strain, but to up-hill and down-hill labour,—that is, by great exertion relieved by complete rest. And the muscles of the larynx obey the same laws that govern any other muscle, wherever situated. Over-use, moreover, produces a congested condition of the lining membrane of the vocal apparatus, a state of matters which generally requires the application of special means for its removal, in addition to complete rest of the larynx.

Falsetto.—The human voice is susceptible of two different kinds of tones,—one, which is the voice with which we ordinarily and naturally speak, and termed, therefore, the *natural voice*, or *chest voice;* and the *falsetto voice*, which latter has more of a humming character, and is produced when sounding the higher notes only, particularly in males. The lower notes can be produced only by the natural or chest voice. The two series of tones have not, however, any distinct line of demarcation separating them ; but they merge insensibly the one into the other ; so that in notes of the middle pitch we may have either the chest notes or the falsetto. When the vocal cords are much relaxed we have the chest notes produced, and this, however forcibly we may pass air through the glottis. When the cords, again, are put more on the stretch, we may have either of these tones evolved,—sometimes the one, sometimes the other; while, with still more tension, the falsetto tone is the constant result, whatever may be the force of the current of air through the glottis. In slight tension of the cords, a gentle stream of air through the glottis will give the falsetto; while, with the same tension, but with a stronger current, the natural voice is produced.

The production of falsetto notes is due, as Müller affirms, to the thin lips or edges only of the glottis being thrown into vibration; while, in the natural or chest tones, it is the whole breadth of the glottis—cords and all—that is thrown into strong vibrations.

CHAPTER VIII.

(*B.*)—THE EXTRINSIC MUSCLES OF THE LARYNX.

THESE, all of which occur in pairs, affect the movement of the larynx *as a whole;* fixing, elevating, or depressing the *entire organ*, as in the act of deglutition, &c. Their influence upon it is as upon one piece; they have little or no power to change the relationship, one to another, of the individual cartilages of the organ, thus differing altogether, therefore, from the action of the group last considered.

Arranging the extrinsic muscles into the two classes already briefly named, we have—(1.) the muscles which act upon the larynx in a *direct* manner, or which are directly affixed to it by one part, namely:—

The sterno-thyroid (two),
The sterno-hyoid (two), and the
Middle and inferior constrictors of the pharynx;

(2.) those which, not being *directly* attached to the larynx, affect its movements in an *indirect* manner, namely:—

The sterno-hyoid (two),
The omo-hyoid (two), and the
Muscles of the supra-hyoid region.

I. **The Sterno-Thyroid Muscle.**—This is placed between the top of the *sternum* (or breast-bone), to which it is attached by one end, and the thyroid cartilage, to the oblique line on the outside of which its upper end is inserted. (See (*a*), Fig. 13.) When in action, the muscle depresses the thyroid cartilage, and, therefore, the whole larynx; and since, moreover, the hyoid bone has intimate muscular relation with the thyroid cartilage, it follows that the depression of the thyroid cannot be very great without the hyoid bone partaking of the same movement, and it may, therefore, also assist in the descent of this bone, and especially so when the thyro-hyoid muscle comes into play simultaneously with the sterno-thyroid muscle.

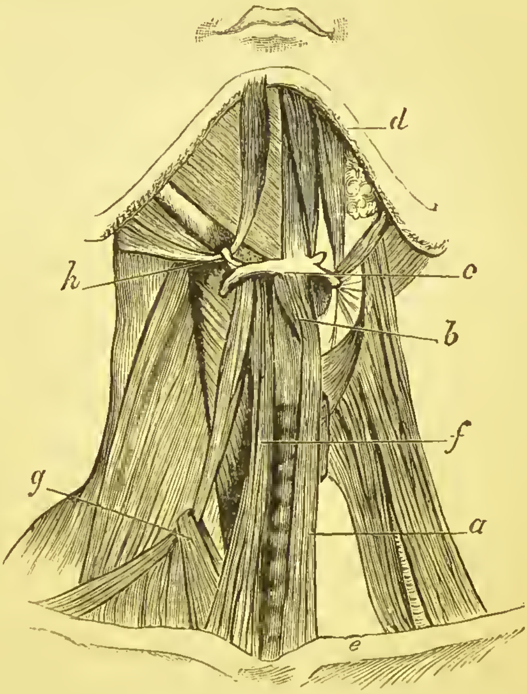


Fig. 13.

View of the Extrinsic Muscles of the Larynx.

(*a*) The sterno-thyroid muscle, left side; (*b*) The thyro-hyoid muscle; (*c*) The hyoid bone; (*d*) Lower jawbone; (*e*) The collar bone, left side.

II. The Thyro-hyoid Muscle. (*b*, Fig. 13).—This would appear to be a simple prolongation upwards of the preceding muscle, as it takes its rise from the same line (the "oblique line" of the thyroid cartilage) as that in which the sterno-thyroid muscle terminates,—from which line it passes upwards to be inserted into the hyoid bone (*c*, Fig. 13), at its lower border and great horn, near the union of this latter with the body of the bone.

Action of the Muscle.—When the hyoid bone is *fixed*—that is, when it is rendered for the time being immoveable by the action of other muscles—it draws the larynx upwards; but when, on the contrary, the larynx is the fixed point, the muscle will draw down the hyoid bone, either of itself or in conjunction with the preceding muscle just considered.

III. The Middle and Inferior Constrictor Muscles of the Pharynx.—These are more especially devoted to the service of the pharynx, which is embraced by their fibres. But as they are attached to and take origin from the larynx, they are necessarily (though cursorily) alluded to here. The *superior* constrictor (there are altogether three constrictors) performs similar duties to the pharynx as do the pair under notice; but as its fibres take origin from other parts than the larynx, and exert no special influence upon the latter, it is unnecesary to treat of it further.

The Inferior Constrictor (*a*, Fig. 14) takes origin both from the cricoid and the thyroid cartilages,—its attachment to the cricoid being on the side of the cartilage, and to the thyroid on its oblique line, —the same part, it will be remembered, that gives origin to the thyro-hyoid muscle. From these parts the fibres pass, expanding as they go, to the middle line of the pharynx behind, where they join the fibres of the companion muscle from the opposite side. The upper fibres, which lie very obliquely to the long axis of the pharynx, overlap the lowermost fibres of the muscle placed above it,—that is, the middle constrictor; whilst the fibres constituting the lower border of the muscle are placed in almost a horizontal manner, as seen in the Figure (Fig. 14).

The Middle Constrictor (*b*, Fig. 14) arises from the hyoid bone, and chiefly from its great horn at its upper border, as seen in the Figure—and also from the lesser horn, as well as from a ligament in this situation. It thence spreads outwards, fan-like, both in an upward and downward direction, to be inserted, like the inferior constrictor, into the middle line of

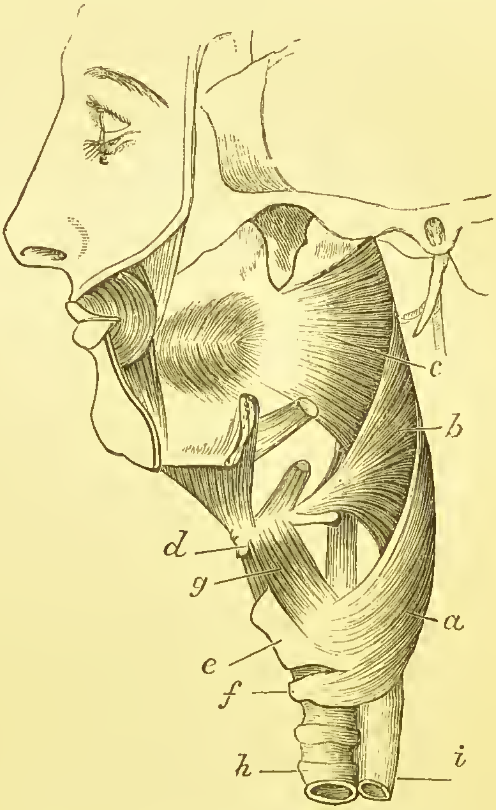


Fig. 14.

(*a*) Inferior constrictor of the pharynx; (*b*) The middle, and (*c*) The superior constrictor; (*d*) Body of hyoid bone; (*e*) Body of thyroid cartilage; (*f*) The cricoid cartilage; (*g*) Thyro-hyoid muscle; (*h*) The wind-pipe; (*i*) The gullet.

the pharynx behind, along with the fibres of the muscle of the opposite side. The arrangement of the upper fibres is similar to the corresponding portion of the inferior constrictor, in that they overlap the lowermost fibres of the muscle placed above it,—the *superior* constrictor;—its own lower fibres being in like manner covered by the muscle below it,—the *inferior* constrictor.

Action of the Constrictors of the Pharynx.—As their name implies, they "constrict," or narrow, the calibre of the pharynx, constituting the initiatory motive-power that propels food, &c., down into the gullet, until it comes within the influence of the muscular fibres of the latter, to be by them forced into the stomach. They exert but little influence upon the movements of the larynx, tending only to draw this upwards, and a little backwards; and chiefly by the uppermost fibres of the middle constrictor.

IV. **The Sterno-Hyoid Muscle.**—This, a long flat strip, takes origin from the top of the breast-bone, and also in part from the adjoining end of the corresponding collar-bone; and thence passes almost perpendicularly upwards, approaching, when half-way up, its fellow muscle of the opposite side, and then again diverging, it becomes affixed by its upper end to the lower border of the body of the hyoid bone. In its journey it lies upon the sterno-thyroid and the thyro-hyoid muscles, both of which it partly hides from view. The muscle of the right side is shown by *f*, Fig. 13; the muscle of the left side having been removed.

Action.—It depresses, or pulls down, the hyoid bone; a movement which always takes place immediately after the act of deglutition. During this latter operation the hyoid bone, as also the thyroid cartilage, become suddenly elevated; as may be felt by the finger placed on these bodies during the act of swallowing water, &c. After the act is accomplished, the thyroid cartilage and the hyoid bone are brought back to their original position, as the finger can readily perceive; and this is accomplished by the action of the muscle under notice.

This descent of the thyroid cartilage and of the hyoid bone also takes place during the evolution of a low note in music, &c. This latter remark as applying to the thyroid cartilage will strike the reader as being contradictory to that made at page 39, where it is stated that the descent of the thyroid cartilage may be made apparent to the finger by *elevation* of the pitch of the voice. The contradiction is, however, only apparent; the statement originally made not applying to *extremes* of pitch. For when the voice is strained to sound a note only a little above the average pitch, it is the *whole larynx* which ascends the neck; the descent of the front of the thyroid cartilage towards the cricoid still taking place, though it is not then perceptible in consequence of the disproportion that exists between the extent of the opposite movements,—the degree of ascent of the *whole organ* more than counter-balancing the extent of the descent of the *thyroid cartilage* upon the cricoid, in front.

V. The Omo-Hyoid Muscle (*g*, Fig. 13).—This, long and slender, is a *double-bellied* muscle; that is, a muscle having its fibres arranged into two distinct masses, these being joined together in the middle by a tendon. The omo-hyoid is attached by its lower end to the upper border of the shoulder-blade, from a notch in the bone near the shoulder-joint; from this it passes forwards and slightly upwards towards the front of the neck, till its central tendon is reached, when its course becomes changed to an almost perpendicular direction to its termination in the lower border of the hyoid bone,—just external to the attachment of the sterno-hyoid muscle last considered. The central tendon is kept in place, and the angular direction of the muscle determined by a loop of fascia, through which the tendon of the muscle plays. In Fig. 13 the letter *g* points to the loop through which the tendon of the muscle plays.

Action.—Its effect upon the hyoid bone is similar to that of the sterno-hyoid muscle; that is, it draws down the bone, as explained in connection with the muscle just named.

VI. The Muscles of the Supra-Hyoid Region.—All these act upon the larynx *indirectly*, through their connection with the hyoid bone, this latter being, as we have seen, intimately associated with the larynx by means of the muscles already discussed. The muscles in this group which we must notice (however briefly), are named as follows,—the nomenclature being, if we except the first on the list, in accordance with the names of the parts to which they are respectively attached :—

The digastric.
The stylo-hyoid.
The mylo-hyoid.
The genio-hyoid.
The genio-hyo-glossus.
The hyo-glossus.

(*a.*) *The Digastric (or "Double-Bellied") Muscle.*—This is similar, in the arrangement of its fibres into two separate masses, and in the union of these by a tendon, to the omo-hyoid muscle last noticed. It takes origin by its posterior "belly" from a groove in the temporal bone (just behind the ear), from which it passes forwards and slightly downwards towards the hyoid bone, to which the central tendon is held by a fibrous loop attached to the body and great horn, and through which the tendon runs, as in the case of the omo-hyoid muscle and *its* tendon. From this point its course becomes changed into one almost directly upwards, near the central line of the neck in front, to be finally inserted into the lower border of the jaw-bone, close to the middle line. In Fig. 13, the letter *h* points to the central tendon, and the loop through which it plays, of the muscle of the right side.

Action.—The anterior "belly," when acting alone—and each "belly" may, owing to its separate nerve supply, contract independently of the other—draws the hyoid bone upwards and a little forwards, a movement which invariably takes place during the first stage of deglutition. The posterior "belly" pulls the bone upwards and backwards, as happens when the pitch of the voice is raised. When the muscle acts by both its masses simultaneously, the effect will depend upon whether the lower jaw or the hyoid bone be the fixed centre. If the former, the hyoid will be raised; if the latter, then the lower jaw will descend, and the mouth be opened.

(*b.*) *The Stylo-Hyoid Muscle.*—This, long, slender, and spindle-shaped, is situated close behind and beneath the posterior "belly" of the above considered muscle, and likewise takes origin from the temporal bone, just at the base of a spike-like projection (termed the *styloid process*), from which point it takes the same course as the posterior "belly" of the digastric muscle towards the base of the great horn of the hyoid bone, and becomes inserted into that bone, just where the horn joins the body. Near this attachment the fibres of its tendon generally separate into two portions or bundles, in order to allow of the passage through the opening thus made, of the tendon of the digastric muscle. In Fig. 15, the letter *a* points to the stylo-hyoid, at the place where this opening exists; *b*, the styloid process; *c*, the hyoid bone.

In its action it is an assistant to the posterior "belly" of the digastric muscle,—raising the hyoid bone upwards and backwards during the evolution of a high note in music, &c.

(*c.*) *The Mylo-Hyoid Muscle.*—A broad and thin muscle. Joined to its fellow of the opposite side, it stretches across the lower jaw, and forms a floor to the mouth at its front part. It is affixed to the lower jaw along a ridge named like the muscle, and extends along the inner surface of the bone, from the front backwards, as far as the last tooth. From this large origin the fibres pass backwards and inwards, till the great mass of them meet those of the muscle from the opposite side, half-way; where they join together in one tendinous line (termed the *raphé*). The rest of the fibres, and which constitute the most posterior part of the muscle, are attached to the whole body of the hyoid bone, at its under surface. Its situation is indicated by *d*, Fig. 15, the letter pointing to the cut edge of the muscle.

Action.—Like the anterior "belly" of the digastric muscle, it draws the hyoid bone upwards and forwards during the first stage of deglutition.

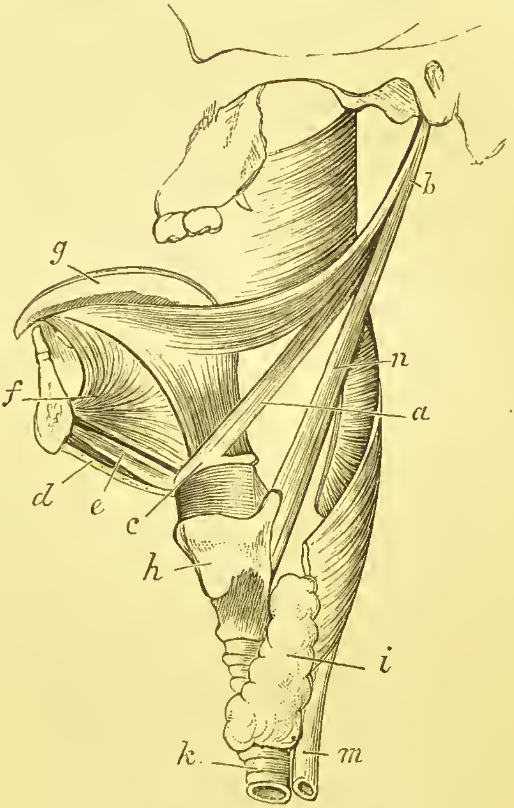


FIG. 15.

(*a*) The stylo-hyoid muscle; (*b*) The styloid process; (*c*) Hyoid bone; (*d*) The mylo-hyoid muscle; (*e*) The genio-hyoid muscle; (*f*) The genio-hyo-glossus muscle; (*g*) The tongue; (*h*) The thyroid cartilage; (*i*) The thyroid gland; (*k*) The windpipe; (*m*) The gullet; (*n*) The stylo-pharyngeus muscle.

(*d.*) *The Genio-Hyoid Muscle.*—This (*e*, Fig. 15) rests upon the last-named muscle. It passes from a tubercle on the inside of the lower jaw, at the middle line, in front, to the hyoid bone, and is attached to the body of this bone in front. It lies in contact with its companion muscle of the opposite side throughout its whole course. Its *action* is similar to the muscle last described.

(*e.*) *The Genio-Hyo-Glossus Muscle* is thin and fan-shaped, and has three points of attachment—the lower jaw, the hyoid bone, and the tongue; hence its threefold name. The apex of the muscle is fixed to the lower jaw behind the central line, in front (see Fig. 15, *f*), from which point its fibres spread both upwards and downwards, the two surfaces looking sideways, and the muscles of the two sides almost touching each other. The lower fibres attach themselves to the body of the hyoid bone; the upper pass into the central line of the tongue, right to its tip, and constitute a portion of the substance of that organ.

Action.—The muscle has more than one duty to perform. The contraction of some of its fibres—those, namely, at the posterior part of the tongue—*protruding* this organ from the mouth; others, the most anterior fibres, *retracting* it; while others, again, the middle fibres, *depress* the tongue in the *middle line.* The lowermost fibres, likewise, pull the hyoid bone forwards and upwards, and thus assist the genio-hyoid muscle. These various actions of the muscle will readily be understood by reference to Fig. 15, *f*, which shows the attachments of the muscle.

(*f.*) *The Hyo-Glossus Muscle*, thin and quadrangular, lies vertically between the hyoid bone and the tongue, the hyoid attachment being from the whole length of the great horn, the side of the body, and from the little horn; the upper attachment is to the side of the tongue, and it constitutes a portion of this organ.

Action.—It acts as an opponent to a muscle termed the *stylo-glossus* (which latter, during the act of deglutition, raises the sides of the tongue, and thus forms a hollow channel for the safe passage backwards of the food), depressing the sides of the tongue, and so causing the upper surface of this body to assume a convex form. Besides this action, however, the muscle has some little control over the movements of the hyoid bone, assisting in raising this bone (when the tongue is fixed), and in keeping it steady on other occasions.

The preceding group of muscles act, as we have seen, upon the larynx as a *single body*, and not upon its individual cartilages, over the movements of which latter they have no influence, except by changing the position of the whole organ. Some of the muscles elevate the larynx, as happens during the evolution of a high note in music, &c.; others, again, depress it, as in the second stage of deglutition, the sounding of a deep bass note, &c.; while a third set, the larynx and the hyoid bone being the fixed centre, act mainly upon the movements of the tongue, and into the formation of which they freely enter.

Surrounding the larynx and its muscles, &c., as with a sheet of cotton-wool, is a multitude of small hollows or cells filled with fat, and which act not only as a protection against sudden changes of external temperature, but also as a most useful and efficient *packing* for filling up the interstices and vacant places between the various organs and parts, such as the blood-vessels, &c., and promoting, also, free and smooth movement between the different parts. By such means all angularities of hard structures are rendered even and harmless, and made comparatively smooth, so as to present no troublesome obstacle to that easy, graceful, pleasing movement which we so much admire in ordinary machinery. Besides this layer of *cellular tissue*, as it is called, there are also certain other layers or sheets of *fascia*, designed to keep the different structures in the neck in their own respective places. These sheets of fascia form sheaths for the blood-vessels, the nerves, the tendons of the various muscles, &c., besides acting as a general protective agent to the parts which they invest. And last of all comes the skin, or integument, wrapping up and covering over the parts beneath, as with a blanket ;—warning the subject by its sensitiveness to external impressions, of threatening danger from without,—such as excessive coldness of the air, &c. ; or, on the contrary, of abnormal and dangerous degrees of heat. By its multitudinous sweat-ducts, and other minute channels, it carries off from the economy a vast quantity of effete material, which, if allowed to remain in the system, would prove highly injurious to the whole animal organisation.

THE THYROID GLAND.

At the lower part of the neck, and surrounding the upper part of the windpipe, reaching also up the sides of the larynx, is placed the thyroid gland. It is figured, in part, at page 67 (*i*, Fig. 15), where a view of the left half is given. It derives its importance chiefly from its liability to undergo enormous augmentation in size; and then exercising so much pressure upon the organs and parts in its immediate vicinity, as to give rise to serious mischief, or even positive danger to life.

Anatomically, it consists of two halves, placed one on each side of the larynx and windpipe, joined together at their lower ends by a narrow neck, which passes in front of the windpipe, and beneath the muscles ascending to the larynx and the hyoid bone. The great vessels which pass up the neck lie beneath it. *Its function* in the animal economy is not fully understood, but it is thought to have some influence upon the elaboration of the blood.

The continuation of the larynx downwards brings us to the main windpipe, or *trachea;* and which we must now proceed to consider.

CHAPTER IX.

THE WINDPIPE, OR TRACHEA.

THE main windpipe, or *trachea*, is formed, as mentioned incidentally in a previous place, by the union of the two first, or largest bronchial tubes, one from each lung at the root of the neck; from which situation it extends up the neck till it joins the larynx. It measures about four inches in length, and nearly one inch in diameter, from side to side; the measurement from before backwards is somewhat less, owing to its generally circular form becoming at the posterior surface, where it rests upon the gullet, somewhat flattened. It is seen in Figs. 14 and 15. It is a little larger in the male than in the female.

In structure it is chiefly cartilaginous. The cartilages assume the form of rings. They are about fifteen or twenty in number, and are placed at intervals in a concentric manner, so as to maintain the circular shape of the tube, and the patency of its internal calibre, under a considerable degree of pressure. The rings are deficient at the posterior parts, where the windpipe rests upon the gullet; but they extend around the rest of the tube, forming about two-thirds of the whole circumference. The last or lowermost ring has its lower border prolonged into a triangular process, which, by curving backwards at the point of division of the trachea into the two bronchi, strengthens and gives increased support to what would otherwise be the weakest part of the whole tube.

The rest of the windpipe is formed of *fibrous membrane*, *muscular fibres*, *elastic tissue*, and *mucous membrane.*

(*a.*) *The Fibrous Membrane* forms the basis or foundation of the substance of the tube; the rings of cartilage just mentioned, being embedded in it,—the fibrous tissue passing from ring to ring, and constituting the chief connection between them. It likewise extends behind the rings, filling up, and joining that part not completed by the cartilaginous rings. It also covers the rings on their outer, though not on their inner, surface. The fibrous membrane is a very elastic substance; one of its fibres admitting of being stretched to twice its ordinary length, when it afterwards immediately returns to its former proportions.

(*b.*) *The Muscular Fibres* likewise pass across the space left vacant by the cartilaginous rings. The muscular fibres are placed within, or internally to, the fibrous tissue.

(*c.*) *The Elastic Tissue* is arranged in bundles, and placed in a longitudinal manner within the cartilaginous rings, and internally to the muscular layer, behind.

(*d.*) *The Mucous Membrane* is spread all over the internal surface of the trachea, constituting its internal lining or covering. It is continuous with that lining the bronchial tubes, below; and the larynx, above,—

the membrane being, in fact, the same in all these parts. Opening upon its free surface are the mouths of a great number of tubes, leading from a corresponding number of glands, termed *mucous glands*, placed within the membrane, and whose function consists in the secretion of a glairy, but thinnish, fluid, called *mucus*. It is this mucus which keeps the membrane in a moist condition, and which condition is so very essential to the due discharge of its important duties. On the surface, also, is placed a fine and peculiar covering, which may be looked upon as its protective coating or armour. This is the *ciliated epithelium*, and is depicted in the margin (Fig. 16). It is provided on its free surface with a multitude of extremely fine hair-like bodies, termed the *vibratile filaments* (*a*, *a*). The filaments are not, however, hairs simply, lying like fur on the coating of an animal's back; but they are a distinctive and peculiar formation. They are always in motion—paddling from within outwards; the mucus secreted by the membrane (as mentioned above), until this viscid matter, coming within the influence of the structures at the top of the throat, it is coughed up, and thus got rid of. The presence of ciliated epithelium on the free surface of the mucous lining of the air-passages, is a provision of the highest import-

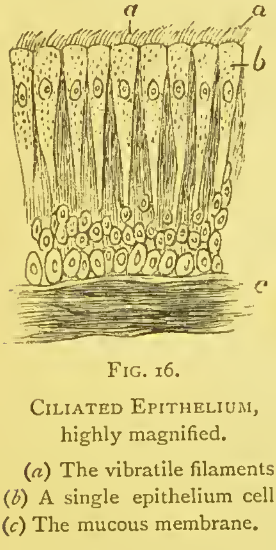


FIG. 16.

CILIATED EPITHELIUM, highly magnified.

(*a*) The vibratile filaments; (*b*) A single epithelium cell; (*c*) The mucous membrane.

ance. For it keeps these passages in an open and cleanly condition, and thus maintains a free and unobstructed passage for the air of respiration as it passes to and from the lungs. It is a provision as wonderful and effective as it is wise and simple. In the smaller air-tubes, which do not, as we shall presently see, exceed the one-thirtieth of an inch in diameter—some of them even less—it is, as will readily be seen, of the utmost importance that some such provision as the above should be adopted for keeping them from becoming blocked up and occluded. Were it otherwise, what with the mucus which smears their internal surface, and the presence of small but innumerable particles of dust, &c., which is being almost continuously carried in with the inspired air—there would soon be great difficulty for any air at all to find its way into them; and, more particularly, into the ultimate ramifications of the air-tubes.

The windpipe having, in its passage downwards, reached the root of the neck, it there divides into two branches—one to each lung; the branches being termed, respectively, the *right* and *left bronchus*. Each of these then shortly divides into two lesser branches; and these latter, again, into two still smaller. And thus the division and subdivision continues, each air-tube splitting up into two still finer tubes, till the latter ultimately become so numerous as to be almost incalculable, and of such fineness that from thirty to fifty of them do not, when laid side by side, occupy more than one inch of linear space. The windpipe and its divisions may therefore be roughly represented by the trunk of a tree and its roots,—the latter dividing, and subdividing, into *rootlets* and *radicles* of extreme fineness. The smallest bronchi terminate in small *culs-de-sac*, termed *air-cells*, which latter we shall take up more fully in the next chapter.

CHAPTER X.

THE LUNGS.

In accordance with the plan originally mapped out (page 3) for our guidance in the consideration of the vocal apparatus and accessory parts, we now come to the most important in the latter category—namely, the apparatus employed by the animal organism for the collection, temporary storage, and final expulsion of the air, whose passage over the vocal cords causes, as we have seen, their vibration, with the resulting evolution of sound, or of articulate language, as may be desired. We use the words "*employed* for the collection," &c., of the required air, because the lungs were primarily designed for, and are unceasingly used in, the function of respiration,—this action being indispensably necessary for the purification of the blood ; for this process of blood purification cannot take place, nor life itself be maintained—in man, at any rate—without the special instrumentality of the lungs. When, however, in the animal organisation, more than one act or function can be as conveniently, as effectively, and at the same time more economically performed by some organ or part not primarily or specially created for the discharge of that one duty, than by the presence of a *special* organ for such purpose, the former is invariably charged with this minor, or secondary, duty also. It could, of course, have been quite easy for the great Designer of our wonderfully constructed bodies, to have formed and appointed an apparatus, or system, to be devoted solely to the discharge and service of the vocal functions; but since the same results could be attained by placing the vocal mechanism in the respiratory tract, it would have been a waste of means and material to create a separate system of machinery for the purpose. The respiratory system (the lungs, &c.) is therefore brought into requisition for the discharge of the vocal duties also,—there being no loss of power, or waste of material, by the adoption of such a plan; but, on the contrary, great gain,—not the least of which is in simplicity of construction, and in the subsequent working of the machinery.

As most people know, the lungs are situated within the thorax or chest, one on each side; and together with their air-tubes (the *bronchi*), and the heart and its large blood-vessels, &c., fill its entire cavity. Each lung is of a conical form, its apex being uppermost; and it is separated from its fellow-lung by a membranous partition, termed the *mediastinum*. Both lungs are covered with a serous membrane, termed the *pleura*, are closely applied to the concavity of the chest-walls, and are, therefore, necessarily of a convex form where so applied. But centrally, and internally, where room is required for the heart and its large blood-vessels, and between which these structures lie, they are of a concave form, corresponding with the convex outline of the heart. The lungs are concave, also, at their bases, where they rest upon the convex partition (the *diaphragm*) that divides the chest from the abdomen. The apices extend upwards above the first or top ribs, a little into the root of the neck.

The right lung is divided into three parts, called *lobes*, by two deep fissures: one, extending from the top of the lung, behind, to near the anterior angle below; and the other, commencing from about the middle of this fissure, and terminating at the front border of the lung. The right lung is larger than the left, owing to the latter having the heart more inclined to the left side of the chest. It is, however, the shorter of the two, in consequence of the liver pressing up the diaphragm on the right side.

The left lung has only two lobes, and it weighs less by a couple of ounces than the right. The combined weight of both lungs is about forty ounces; from which it will be apparent that though the lungs are designed for containing air, yet they are not *bags* simply—as are, for example, the reservoirs employed for the storage of air in the common bagpipes, &c. On the contrary, the internal construction of the lungs is more like a piece of cut sponge or honeycomb, being formed of countless numbers of small cavities or cells, termed the air-cells, and permeated by thousands of air-tubes, blood-vessels, &c.,—all held together, and at the same time kept separated, by the lung-tissue proper. And this lung-tissue, if separated from the air-tubes, blood-vessels, &c., would be found to constitute but a very insignificant proportion of the total weight of the organs.

It is these **Air-cells**, together with the tubes and passages communicating with them, that serve as the reservoir for the storage of the air employed in setting in motion the vocal cords. The cells are exceedingly small, averaging in diameter only the $\frac{1}{70}$th to the $\frac{1}{200}$th of an inch. But their *number* is immense. They constitute the ultimate terminations of the air-tubes; or rather, they are the *culs-de-sac* covering the internal surface of the ultimate *expansions* of the air-tubes, near the external surface of the lungs. A bunch or group of these cells is found at the termination of every minute air-tube, and such a collection or group is termed a *lobule* of the lung, the minute passages leading to them being distinguished as *intercellular passages.* The marginal figure (Fig. 17) represents in diagram one of these *lobules*, with its *air-cells* and *intercellular passage.*

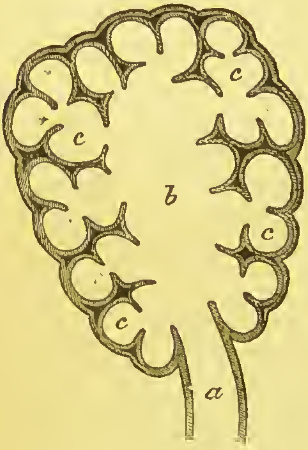


FIG. 17.
DIAGRAMMATIC VIEW OF ONE OF THE LOBULES OF THE HUMAN LUNG, highly magnified.

(*a*) Intercellular passage; (*b*) Cavity of lobule; (*c*, *c*) Air-cells.

The air-cells are thickly surrounded by minute blood-vessels, termed the *capillaries*, which have very thin walls, and it is almost wholly in, or rather around, these cells that the important and indispensable function of the :—

Aëration of the Blood is effected. This fluid, on leaving the capillaries, is found to be changed in colour, from dark-blue, or black, to red, or scarlet, by the abstraction from it of *carbonic-acid gas*, &c., and the substitution of *oxygen gas* from the inspired air,—the former gas being carried out of the system during the act of expiration. It is to effect this change in the character and composition of the blood that the act of respiration takes place,—the purification of the blood being the primary and chief function which the lungs have to discharge. During each respiratory act, fresh air is taken into the lungs—that is, into the air-cells—where it is subjected to the chemical change above mentioned: oxygen being given to the dark, impure blood, and carbonic acid, which, if allowed to remain in the fluid, would poison the economy, abstracted from it, and immediately passed out of the system by the act of expiration. Both the air inspired and the blood are thus changed in character and composition, a process which must be unceasingly kept up, not only to maintain the health, but the very life of, the individual. On leaving the lungs, the air, owing to its being now deprived of free oxygen, is not only *not* fitted for re-inspiration, but, from the addition to it of the carbonic acid, &c., it has become absolutely *poisonous* for respiratory purposes. So that, by excluding, for example, from a room all means of ingress to it of fresh air, and preventing all egress from it of that already expired, death to the inmates would certainly result after the unused air had become exhausted of its free oxygen by the act of respiration. And there are, unfortunately, many sad instances on record of deaths happening from this cause,—the want, namely, of a sufficient supply of fresh air. It is only necessary, however, to remind the reader of the terrible story of the *Black Hole of Calcutta*, which story could not have been written—because the catastrophy could not have taken place—had there been a sufficient supply of fresh air to the poor imprisoned soldiers. It cannot, therefore, be deemed superfluous to impress upon the reader the importance of attending to this matter. He should, indeed, exercise every care possible in guarding against bad ventilation, and especially in rooms liable to become much crowded. Without this all-important provision —plenty of fresh air, namely—his health is sure to suffer; his lungs will lose their wonted freshness and buoyancy of action, and his vocal apparatus that vigorous tonicity and elastic property on which the integrity of the voice so much depends. No amount of *general* care—as by careful attention to the food we eat, either as regards quantity or quality; or the clothes we wear; or the adoption of such of the rules and habits of life as are considered best and the most conducive to health—will ever compensate for an imperfect supply to the lungs of pure atmospheric air. Vocalists, public speakers, &c., should therefore make it a prime duty, not only to guard their lungs from sudden changes of temperature, to be careful against catching cold, and such-like evils, but to see that they inhale, as far as possible, this all-important body in a condition as pure and as unvitiated as it is possible to be got. Nothing will more effectually protect them against that feeling of heaviness and oppression at the chest, that unaccountable dulness and cloudiness of the mental faculties, &c., of which many of this class are so frequently the subjects, than the constant respiration of pure uncontaminated atmospheric air.

The Intercellular Passages are, as we have already remarked, the ultimate terminations or expansions of the bronchial tubes; these latter resulting, as we have also seen, from the bifurcation and subsequent division and subdivision of the main air-tube, a little after it has entered the chest. At the places where the bronchi begin to be termed the *intercellular passages*, they are not of greater diameter than the $\frac{1}{30}$th or the $\frac{1}{50}$th of an inch, and at this part of their course they are situated close to the surface of the lung, or about $\frac{1}{8}$th of an inch from it.

CHAPTER XI.

THE CAPACITY OF THE LUNGS; AND TIGHT-LACING.

(*a.*) By the "capacity of the lungs" is meant the amount or volume of air which the lungs are capable of containing at one time. And this varies according to circumstances;—the chief of these being the height of the individual; the position or attitude of the body at the time the test is applied; the person's weight; age; and the presence or absence of disease. The greatest quantity of air which a man can expel from his lungs at one time, by the greatest voluntary effort immediately succeeding the greatest voluntary inspiration of air, is technically termed the VITAL VOLUME, or VITAL CAPACITY; and this is easily determinable by an instrument called the "spirometer," invented for the purpose, into which the individual, after having first loosened the clothes about his chest, and taken as deep an inspiration as possible, empties his lungs through a mouthpiece. An indicator attached marks off the number of cubic inches of air blown into the apparatus by the single expiratory act, and we thus at once ascertain the capacity sought for.

It appears, from a large number of experiments, instituted with the view of ascertaining what condition is the most general or constant that regulates the "vital capacity" of an individual, that the *height* of the person is the chief. In the erect position, the average number of cubic inches which a man of five feet nine inches in height, for example, can expire, immediately after the deepest inspiration, is 246; while another person of five feet ten inches in stature, and whose condition, except that of height, is the same in every respect as that of the former, would expire about 254 cubic inches; and another man, again, one inch taller than the last, would give us about 262 cubic inches; or an increase in each case of eight cubic inches for each additional inch in the height of the individual. And this cubical increase in capacity, according to the progressive height of the individual (between five feet and six feet in height), is the very general rule—that is, *For every inch of stature, between five and six feet, eight additional cubic inches of air, at the usual temperature of 60° Fah., are given out by the deepest expiration immediately succeeding the deepest inspiration.* Of course, this rule applies only to persons in good health; for, as we have already remarked, the "vital capacity" is also influenced by disease, and more especially by disease of the lungs, of which more will be said presently.

By carefully taking the stature of an individual, and comparing this with the "vital capacity" obtained, as indicated by the spirometer, the medical man may be led in certain doubtful cases to form an opinion of considerable importance in the examination of that person, and one of the greatest value both to the man himself and to his friends, not to mention its pecuniary worth to life insurance companies, &c., in cases where a policy is being sought from them. Say, for example, that the person under examination stands five feet nine inches, and, on taking his "vital capacity," we find this to be, say 160 cubic inches, instead of 246 cubic inches—the volume which, as we have seen, a man of the stature given should in health be able to expire—we should at once suspect serious mischief within the chest, and on examination by the usual physical methods, we should almost certainly discover disease therein.

As the imperial gallon contains about 277 cubic inches (277·274), we learn the fact that a man of six feet in stature should, if his lungs be in a normally healthy condition, and no other impediment, mechanical or otherwise, be present, expel from his lungs by one forcible expiration nearly this quantity of air—almost eight pints!—a far greater volume than the majority of people would have thought possible.

The manner in which *weight* affects the "vital capacity" is chiefly by the presence in the individual of an excess in the amount of fat, the weight being therefore augmented. This excess in fat-tissue acts upon the "vital capacity" mainly in a mechanical manner. It surrounds the lungs, for example, and breathing tubes, in masses so large as to interfere with their full expansion during inspiration, and as the quantity of air expired, or capable of being expired, is strictly regulated by the quantity inhaled, and as this latter is regulated by the degree to which the chest can expand, we see at once how this excess operates. When, moreover, this condition (excess of fat) has become far advanced, by reason either of some peculiar diathesis, or by approaching old age, a still more efficient cause comes into operation, and one of far more serious import, since it is much less amenable to treatment. We allude to what is termed *fatty degeneration* of the various structures of the body, including, of course, the degeneration of the muscles, and of those, therefore, concerned in the movements of the chest-walls. In such case, the muscles, whose duty it is to raise the ribs, by means of which the act of inspiration is performed, become changed in structure by the disappearance of their muscular fibres, and the substitution for these latter of globules of fat. In other words, the substitution of matter possessing no *lifting* power for matter whose very essence is one of active mechanical force. The ribs, therefore, fail in such case to be raised to the full extent, the chest does not expand sufficiently, less air enters the lungs, and hence there is a proportionate diminution in the amount capable of being expired—that is, there is diminished "vital capacity." There are other ways, too, in which excess of fat, or fatty degeneration operates prejudicially to the "vital capacity." It surrounds the breathing tubes themselves, for example, and becomes infiltrated into their muscular walls. Large quantities of fat are found loading the heart, and surrounding the large blood-vessels within the chest, and pressing upon and interfering with the lungs in a mechanical manner. There is this overloading, too, in the abdomen, and this impedes, more or less considerably, the descent of the diaphragm,—a muscular partition, whose duty consists not only in dividing the cavities of the chest and abdomen from each other, but in carrying on abdominal respiration. The lungs being thus mechanically pressed upon from every side—the organs themselves being more or less incapacitated by the metamorphosis of the muscular walls of their air-tubes, &c.—the loss of power in the muscles, whose duty it is to raise the ribs that air may rush into the chest, and the loss of elasticity, both of the lungs and the ribs, by which the air is expelled from the chest, must of necessity, and *do*, as the reader will readily understand, act with a potency more or less marked in diminishing the vital volume.

The only other abnormal factor obnoxious to the integrity of the "vital capacity" to which we shall refer, is that consequent upon the presence of disease within the chest, but particularly of what is termed pulmonary consumption. In this disease, which, it need scarcely be said, is disease of the substance of the lung, the diminution in the vital volume is sometimes enormous. Thus, a man standing, say five feet ten inches, and who in a state of health should, by the rule given, expire by one forcible act about 254 cubic inches of air, might, if suffering from pulmonary consumption, give no more than 170,—a loss of 84. But the loss is not unfrequently much greater, the capacity being in cases stil further advanced, as low perhaps as 145 cubic inches; and occasionally, as in the last stage of the disease, no more than 119,—a loss respectively of 109 and 135! In simple inflammatory affections of the contents of the chest—as of the lungs, or the pleura, &c.—the decrease is often very striking. A man may, for example, have but one lung at his command, the other lung having been rendered impervious to air by reason of the changes which sometimes take place in it as a result of an inflammatory attack, in which case the "vital capacity" must, of course, be very considerably diminished. But enough has already been said, perhaps, to convey to the reader a proper understanding of our subject.

That the reader is fully persuaded that it is highly advantageous, and even important, to the individual that his "vital capacity" should be as great, or at least as near to, the average as possible, we will take for granted. With the vocalist, indeed, or the performer upon such wind instruments as require to be played upon by blowing air through the operator's mouth, this will not be questioned. To these, as well as to ministers of religion, public speakers, &c., it is surely of the last importance, both to their own comfort and to that of their hearers, that the performer should have great command over his respiratory movements, but this he cannot have to any great extent if his "vital capacity" be greatly reduced. What, for example, is more painful to the auditor than to be compelled to sit beneath a puffing, asthmatic, broken-winded speaker? And what more difficult of accomplishment than for a speaker to pour forth a telling, thrilling oration under the adverse conditions just named? Or, again, how futile the attempts of a vocalist to attain to a high mark of distinction, where the power is wanting of prolonging such musical notes as require to be thus sustained, and which power depends so entirely upon the possession of a large "vital capacity"? In short, setting entirely aside all sanatory considerations, it cannot be doubted that, for comfort and convenience alone, it is highly desirable and necessary that the "vital capacity" should be up to the average, or at least not far below it.

By careful and temperate exercise of the respiratory muscles—as by a proper use of dumb-bells, well-directed singing exercise, blowing upon some wind instrument, &c.—the "vital capacity" may not only be kept up to the average, but may be actually increased. And especially does this remark apply to persons before they have attained the middle period of life, and with the utmost benefit also to the general health. There are, of course, certain diseases or conditions of the system during the presence of which it would be inadvisable to practise certain of the foregoing exercises, and which conditions are easily detected by the medical adviser; but, generally speaking, the temperate and intelligent exercise of the respiratory function is attended with the happiest results, and not only as regards the improvement to the "vital capacity," but likewise to the general health of the individual. This statement may prove of vast interest to many anxious parents, &c., but it is likewise of paramount importance to such persons as vocalists, certain classes of musicians, public speakers, &c., who are often called upon to display their respiratory powers to the farthest limits at their command. In this case, proper use—as in the wise exercise of the muscles of the body—tends, not to impoverish and weaken, but to enrich and strengthen. Moreover, it is now well known to medical men that certain *diseases* of the respiratory organs—such as pulmonary consumption, &c.—are very rarely found amongst artists of this class. And some physicians have even gone so far as to affirm that, where the dreaded disease just named has shown a tendency to take up its abode in the system, careful and regulated exercise, under proper surveillance, of the respiratory organs—as by singing, &c.—has been the means not only of arresting, but of totally eradicating, the evil, and of restoring the hitherto tottering constitution to a condition of robust health. Dr. Burg, for instance, a French physician, is a most ardent advocate for well-directed exercise on wind instruments. In a little book, expressly written on this subject, he remarks: "Many philanthropists on seeing our young military musicians wield enormous wind instruments, have sorrowed over the few years the poor fellows would have to live. Well, they are mistaken. All the men whose business it is to try the wind instruments made at the various factories before sending them off for sale are, without exception, free from pulmonary affections. I have known many who on entering upon this calling were very delicate, and who, nevertheless, though their duty obliged them to blow for hours together, enjoyed perfect health after a certain time. I am myself," he continues, "an instance of this. My mother died of consumption; eight children of hers fell victims to the same disease, and only three of us survive, and we all three play wind instruments." So much, then, for this part of our subject.

(*b.*) **Tight-Lacing.**—If the preceding pages have been read and thought over even cursorily, it can scarcely be necessary to point out to the intelligent reader the evils of that now fashionable custom of tight-lacing. For of all the evils which woman brings upon herself in the name of fashion, few, if any, equal this in the injury it inflicts upon her animal economy. By reference to the accompanying figure (Fig. 18), it will be seen that Nature designed that the walls of the chest should gradually increase in circumference from above downwards. But look at the contour brought about at the dictate of fashion, as seen in Fig. 19. Here the arrangement is turned topsy-turvy, the broad end being uppermost, and the apex meeting the apex of another cone—also artificially induced—giving to the entire body the shape of a huge, highly-magnified egg-boiler! And the more this constriction and narrowing of the waist can be effected, the more "fashionable" is the possessor

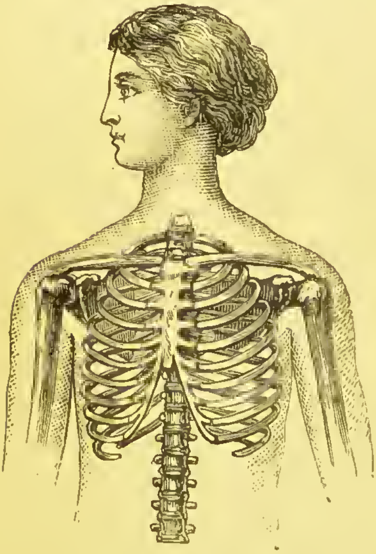


FIG. 18.
NATURAL CONTOUR OF CHEST.

of it supposed to be, and the more enviable does she become to her "fashionable" sisters. Look, too, at the distortion of the ribs, and the fearful havoc made with the backbone! But fashion is an arbitrary and severe ruler, and cares neither for beauty of feminine form, for comfort and convenience, nor—what is most to be deplored—the health and happiness of those who foolishly become her slaves. Some of fashion's freaks, though highly absurd to the beholder, and accompanied by the infliction of an untold amount of inconvenience, not only to fashion's satellites themselves, but to those about them, are yet comparatively free from the objection which appertains to the custom we are now so strongly condemning. But let us consider how the question affects our particular subject.

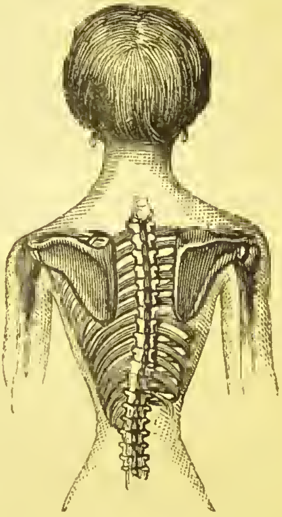


Fig. 19.

Some of the effects of tight-lacing.

The circumference, then, of the waist in a woman of medium height and dimensions, measures, on an average—when not cramped and distorted by the practice under consideration—about thirty inches; but in those who have long adopted tight-lacing it may measure no more than twenty inches, and sometimes even much less. Now, what becomes, in these latter cases, of the several organs contained within the chest and abdomen? They are, of course, compressed, and pushed, and squeezed out of their natural shapes, and made to protrude into places in which they have no business, because never meant to occupy such places. It was intended by Nature, as a matter of course, that the chest and abdomen should respectively hold their various contents in their allotted and relative positions, occupying certain portions of space, and having ample room for the due performance of their individual duties without that jostling and interference with one another which necessarily accompanies disorder and bad arrangement. But, on the other hand, there is no vacuum or empty space in either of the two cavities; there is no region without its own particular organ or part; and each organ or part, though provided by Nature with ample room for the needful and unobstructed discharge of its special function, has yet not much to spare. When, then, any one particular organ is, by the system of tight-lacing, &c., unduly pressed upon, and pushed, and squeezed, it must, like a man in a crowd, since it cannot get out of the way, be seriously hampered in its movements, and its important duties imperfectly discharged, to the no small injury and suffering, sooner or later, of the foolish self-torturer. And this in proportion to the unnatural pressure and squeezing to which the organ has had to submit. The excessive crushing, however, which results from this much-to-be-deplored custom, as well as the consequences arising from it, is not confined to one organ only, but is transmitted to those lying in its immediate proximity,—these having to bear the pressure from the organs which are *directly* implicated, though they themselves may be entirely removed from the direct load,—just as in the case of the middle strata of wool, for example, piled and arranged for pressure in a hydraulic machine, and which are made to feel the weight externally applied, though quite removed themselves from the pressure plates of the machine. And thus the corruption of function becomes widespread, and the integrity of the whole animal economy correspondingly marred and ruined. The practice of tight-lacing brings about this crushing and displacement of organs most completely and effectually, hampering and thwarting them in the performance of their assigned and indispensable duties, and with the consequent production of a whole host of very serious troubles, and not a few real and grave diseases. There are few natural diseases, indeed, which so thoroughly displace, and jam, and wedge together, so great a number of the internal organs, and so generally disseminate amongst them incapacity for the discharge of their multifarious duties, as does this positively sinful practice of tight-lacing. Shortness of breath; congestion, and even inflammation of, the lungs; congestion of the liver; of the kidneys, &c. &c.; palpitation, and subsequent disease of the heart; faintings; bronchitis; indigestion; jaundice; obstruction of the bowels; rupture, &c., &c., are a few only of the many evils arising from the custom which we are so emphatically condemning —a list, one would think, and did experience not instruct us to the contrary, quite formidable enough to cause the most thoughtless, and the most fashionridden subject, immediately to renounce all allegiance to a practice so fraught with mischief, and one, moreover, which has not a single redeeming point, even in the occasionally foolish eyes of the sterner sex in its favour. Where this folly of tight-lacing is kept up, and where the evils just enumerated show themselves, the distortion and the cramping and hampering of the movements of the chest, particularly that of expansion, it cannot, of course, be expected that the "vital capacity" can remain normal, much less that it can possibly become increased. How *can* the chest expand when harnessed round with a coat or case as unyielding as the jaws of an iron vice! And if it cannot expand to allow the proper amount of air to enter the lungs, these organs necessarily fail to become sufficiently dilated, the air cannot enter them, and it cannot, therefore, be expired—that is, the "vital capacity" is reduced, and to a fraction of what it should be.

The remedy is self-evident. First of all, lay aside the pinching corset—"swan-bill," or any other "bill"—which is designed to effect a reduction in the circumference of the waist. And if corsets, or "stays," *must* be worn, let them be wide enough, and laced lax enough, to allow the poor crushed ribs, by their elasticity, to have every chance of resuming the original contour impressed upon them by their Maker. Next, do everything possible to assist the chest in this work of re-establishing its pristine beauty of form, and its consequent power of fulfilling to the utmost its numerous important duties,—one of the most indispensable of which is that of expansion and contraction, whereby the function of respiration is mainly carried on. Plenty of out-door exercise, particularly walking, but not riding in luxurious carriages—horse-back exercise—dilation of the chest by frequent acts of deep and forcible inspiration, especially in the open air—the proper use of the dumb-bells—boating, though not by sails or steam, but by handling the oars ; and many other exercises of a similar character, in which the arms are brought into action and the ribs raised —are some of the means, by the regular adoption of which we shall best succeed in undoing the work which our folly or thoughtlessness has unfortunately effected.

And then will be initiated a movement which will bring in its train such a host of comforts and blessings, that the now happy possessor will always laud and honour the day, when she had the courage and good sense to forswear the practice of tight-lacing.

CHAPTER XII.

THE PHARYNX.

IN the preceding pages we have been devoting our chief attention to the lungs, &c., or the organs that act as a kind of reservoir for the storage of air, and which serve a similar office towards the organs of vocalisation as do, for example, the bellows in the harmonium, &c. In both cases the air is first drawn into these respective receptacles—the lungs and the bellows,—temporarily stored therein, and afterwards expelled with the required degree of force; the air from the lungs passing over the vocal cords, and that from the bellows being directed through certain pipes of the instrument in question. Simple *vibration* of the vocal cords does not, however, produce *articulate language.* The tone evolved by the cords has subsequently to be variously modified by the action of the numerous structures situated above the larynx. Some of these partially intercept the original tone; others split it up into a number of minuter waves; others, again, as it passes on its outward journey, form it into narrow streams, to fall and hiss against the teeth during its exit from the mouth, or direct it, in a greater or less volume, into and through the nostrils, &c.

It is to these secondary, but still indispensable, parts of the animal structures we have now to direct our attention. Beginning with the pharynx, or the part into which the larynx opens, by its upper outlet, we will proceed outwards, till the termination of the journey is reached, at the orifice of the mouth.

The pharynx is the expanded part at the back of the mouth and top of the gullet,—the large chamber into which open the gullet and larynx from within or below, and the nostrils, the mouth, &c., from without or above. It *is*, in short, the upper end of the gullet, which is here enlarged for certain purposes; the enlargement, and, therefore, the commencement of, the gullet beginning opposite the lower border of the cricoid cartilage. The upper boundary is formed by the base of the skull. Besides the larynx and gullet at the lower end, and the mouth and nostrils at its upper part, there are two other openings, of small size, termed the mouths or orifices of the *Eustachian tubes*, one at each side, near the top of the pharynx, and which lead from this point to the middle ears. During the passage of food from the mouth towards the gullet, the pharynx becomes temporarily divided into two portions—an upper and a lower cavity or chamber—by the *soft palate* (to be brought under notice presently), and which at this moment stretches itself, like a curtain, from the roof of the mouth to the back of the throat, and so shuts off communication between the nostrils and the lower chamber thus formed. This arrangement is designed to prevent the food, &c., as it makes its way from the mouth towards the pharynx, from passing backwards by way of the nostrils. After this danger is over, in consequence of the food having passed into the gullet, away from the vicinity of the nasal passages, the muscles of the soft palate relax, leaving matters in the same condition as before.

In structure, the walls of the pharynx are composed of *fibrous tissue*, *muscle*, and *mucous membrane*.

(*a.*) **The Fibrous Tissue** constitutes the basis or foundation on which the muscles and the membrane build, or attach themselves,—in other words, the fibrous tissue is itself the pharynx; the muscles and mucous membrane being mere accessories, but still indispensable accessories. By this tissue the pharynx becomes fixed to the surrounding parts. On its outside are placed the muscles, and lining its interior is the mucous membrane.

(*b.*) **The Muscles of the Pharynx.**—Three of these (the superior, middle, and inferior constrictors) have already been described in connection with the larynx (see p. 60). The remainder, termed respectively the *stylo-pharyngeus* and the *palato-pharyngeus*, one to each side, will detain us but a moment.

The Stylo-Pharyngeus Muscle, a long and slender band, takes rise by its upper end from the styloid process—the spike-like projection of bone that gives origin to the stylo-hyoid muscle, already described (see p. 66), and passing thence, downwards, becomes attached by its lower end to the sides of the pharynx, and to the upper and back borders of the thyroid cartilage (see Fig. 15, p. 67). *Action.*—It has a more decided action upon the thyroid cartilage than upon the pharynx, the former of which bodies it draws upwards and slightly backwards beneath the tongue, during the act of deglutition.

The Palato-Pharyngeus Muscle is a thin, triangular strip, passing from the soft palate, downwards, to the side and back of the pharynx, and to the posterior upper horn of the thyroid cartilage. *Action.*—While the soft palate is raised and made tight by its own upper or superior muscles, the palato-pharyngeus, acting in concert with its companion muscle of the opposite side, shuts off, by its approximation to its companion, the upper part of the pharynx, and therefore the back openings of the nostrils, thus preventing the passage of food, &c., in the upward direction; and at the same time, by the inclined plane it forms downwards, so directs the food as to bring it within reach of the constrictor muscles of the pharynx, which latter thereupon instantly grip the mass and force it into the gullet, which passes it downwards into the stomach.

(*c.*) **The Mucous Membrane** forms the internal lining of the pharynx. It is continuous with that coating the internal surface of the gullet, the larynx, and the air-tubes, and above, with that lining the mouth, the nostrils, &c. It is provided—as in the case of the membrane lining the chief windpipe, &c.—with a number of mucous glands for the secretion of the glairy fluid (*mucus*), whose duty it is to lubricate the membrane, and keep it in a moist and supple condition. That part covering the upper portion of the pharynx is found to be coated upon its free surface with the same peculiar kind of epithelium (the *ciliated*) that protects the surface of the ultimate ramifications of the air-tubes, and which we have seen to be in continuous motion, paddling with its hair-like fingers, from within outwards, such small particles of dust, &c., as may have gained admission into the passages along with the inspired air, and which particles have become arrested and fixed by the glairy mucous secretion just mentioned.

CHAPTER XIII.

THE PALATE.

THE palate is that part of the mouth which constitutes its roof or upper boundary. It is divided into two portions, termed respectively the *hard* and the *soft* palate—the former, the anterior, being formed in its deep portion, of hard bone, covered with mucous membrane; and the latter, the posterior part, of soft muscle, &c., and also covered with the same mucous membrane.

(*a.*) *The Hard* or *Bony Palate* constitutes the chief proportion of the whole palate. It is formed by the projection inwards, and the subsequent union together, of four horizontal plates of bone—two from the upper jaw-bone and two from the "palate-bones." The upper, or nasal, surface of these plates is smooth, and of a concave form from side to side. The inferior or oral surface is arched, and roughened, and marked with grooves for the safe lodgment of the vessels and nerves of the part. On the upper or nasal surface, on the elevated middle line, rests a thin plate of bone, termed *the vomer*, and which, in conjunction with another plate (the "ethmoid plate"), divides the nasal cavity into two lateral and equal halves, corresponding with the openings of the nostrils at the nose. Surrounding the hard palate are the teeth, embedded in the *alveolar* *ridge* of the upper jaw. The hard palate is covered by *periosteum*, and over this is spread the mucous membrane, which also covers or lines the whole of the mouth and the numerous passages at the top of the throat already enumerated.

(*b.*) *The Soft Palate* is the continuation backwards of the mucous membrane, and its reduplication. Its centre is prolonged behind into a small, fleshy, pendant process, termed the *uvula*, or *little tongue;* the rest of the posterior margin being prominently curved into two lines, placed the one behind the other, and constituting respectively, the *anterior* and the *posterior pillars of the fauces.* The former descend to the side of the tongue, and the latter to the pharynx; and in the space between the pillars are placed the *tonsils*, one at each side. The space between the two anterior pillars is termed the *isthmus of the fauces.* The soft palate is not, like the hard palate, a merely *passive* structure; but, on the contrary, it is a very active body, coming into frequent play through the instrumentality of certain muscles, placed, not simply in connection with it by one extremity, but entering into the very constitution of the palate. These muscles, which are arranged in pairs, are named as follow:—

The palato-glossus.
The palato-pharyngeus.
The azygos uvulæ.
The levator palati.
The tensor palati.

Each of these, except the second, which has already received our attention, we must briefly notice.

(1.) *The Palato-Glossus Muscle.*—This, which from its action of constricting the isthmus of the fauces, is termed also "the constrictor of the isthmus of the fauces," is placed in the anterior pillar of the fauces, and constitutes its chief bulk. Its fibres blend with those of the muscle of the opposite side, and, passing down to the side of the tongue, the muscle becomes mixed with the muscular fibres of that organ in one indistinguishable mass or conglomeration. Its *action* is indicated by one of its names; it constricts or narrows the isthmus of the fauces, by drawing tight the anterior pillar, and thus approximating it to its companion pillar of the opposite side. By this arrangement, the bolus of food, &c., during the act of deglutition, and at the moment of its being grasped by the superior constrictor muscle of the pharynx, is prevented from returning to the mouth,—just as the stretching of the soft palate across the upper part of the pharynx prevents, as we have seen, the return of food by the nostrils. And so completely can this communication between the mouth and the pharynx be cut off by the action of the muscles under consideration, that a powerful current or gust of air may be forced from the lungs through the nostrils, without any passing through the mouth, and even with the mouth wide open, a statement which any one may easily verify for himself. The same partial or complete closure of communication between the mouth and the pharynx accompanies the production of a nasal tone; the more marked the tone, the greater the severance between the two cavities.

(2.) *The Azygos Uvulæ Muscle* is a slender band, passing along the middle line of the soft palate, and descending into the uvula, forming, indeed, the chief mass of this body. It is shown in the accompanying figure (Fig. 20, *a*). In *action* it retracts or shortens, and also elevates the uvula, as happens in swallowing food, &c., and in the production of a high note in music. In deglutition it becomes placed between the palati-pharyngei muscles, that is, between the *posterior* pillars of the fauces, and fills up the interval which would otherwise be left between these pillars when they become approximated to each other.

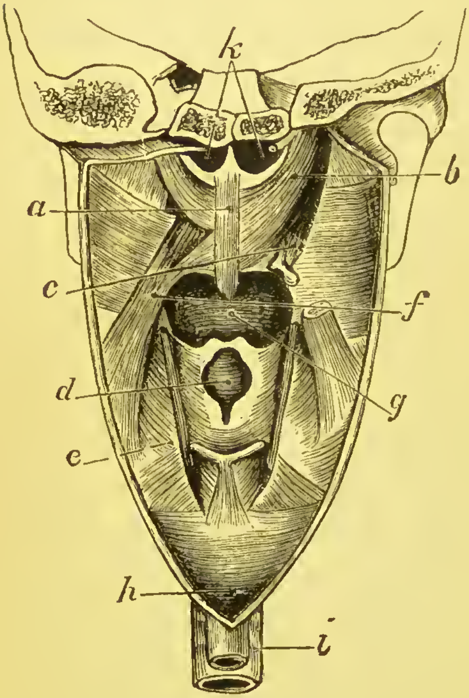


Fig. 20.

View of the Muscles of the Anterior Walls and Sides of the Pharynx, from behind.

(*a*) The azygos uvulæ; (*b*) Levator palati; (*c*) Tensor palati; (*d*) The epiglottis; (*e*) Posterior border of thyroid cartilage; (*f*) Palato-pharyngeus; (*g*) Base of tongue; (*h*) Entrance to gullet; (*i*) Main windpipe; (*k*) The posterior nares. Immediately to right of line *k* is seen inner extremity of right Eustachian tube.

(3.) *The Levator Palati Muscle* is a slender strip arising from the base of the skull, and the cartilaginous part of the Eustachian tube. It thence passes downwards, forwards, and inwards, to its termination in the posterior part of the soft palate, the fibres meeting and blending with those of the muscle of the opposite side (see Fig. 20, *b*). When in *action* it raises and makes tense the soft palate.

(4.) *The Tensor Palati Muscle*—called also the "circumflex palati"—is a neat little band, arising chiefly from the bony structures at the base of the skull, from which it takes its course directly downwards, and by means of a fine tendon, kept smooth by a lubricating fluid, it twists, pulley-like, round a small bony projection, termed the *Hamular Process;* and then changing its direction, it becomes inserted into the tendinous part of the soft palate, in front, and partly into the posterior portion of the palate-bone (see Fig 20, *c*). It presents an example, often met with in the animal organism, of a power acting at a right angle upon the body to be moved, and reminds us of the wheel and pulley so commonly employed in the mechanical arts, when it becomes necessary to change the direction of the operative force. The muscle *acts*, as its name indicates, as a tensor or tightener of the soft palate, and which tightening takes place, as we have seen, in the act of deglutition, and in the evolution of a high note in music, in loud shouting, &c. It is, therefore, an assistant to certain other muscles just described, in stretching the soft palate, curtain-like, across the upper part of the pharynx, and so cutting off the communication which at other times exists between the nostrils and the pharynx.

It is evident from the preceding considerations that the soft palate has two distinct and important duties to discharge. On the one hand, it shuts off all communication between the pharynx and the nostrils, during the act of deglutition, in the sounding of a high note in music, &c.; and, on the other hand, it closes the communication between the mouth and the pharynx by the conjoining of its anterior pillars, as happens during the same act of deglutition, and more or less so when the tone of the voice requires to be more or less of a nasal character.

CHAPTER XIV.

THE MOUTH AND THE LIPS.

The Mouth, more definitely termed the buccal cavity, is the space lying between the lips in front and the throat behind. It contains the organs of taste, and the principal instruments of mastication. Its boundaries are the lips, cheeks, tongue, and the palate; and it is placed, by means of the isthmus of the fauces, in direct communication with the pharynx behind. Its whole internal surface is covered with the mucous lining or membrane already so frequently mentioned. The passage through the mouth over the tongue is termed the *oral canal*, and its opening at the lips the *oral opening*.

The lips and cheeks are constituted of a number of muscles—these forming their chief proportion—enclosed between the skin or integument on the outside, and the mucous membrane on the inside, together with the vessels and nerves of the parts, fat, areolar tissue, and numerous glands.

The Muscles, whose number is rather great, are so arranged as to give the utmost freedom to the movements both of the lips and cheeks and the lower jaw, and, at the same time, strength and protection to the parts within. They are all under the control of the will, and can, therefore, be made either to contract, and with varying degrees of force, or to lie quiescent. It is not, however, here desirable, however much it might conduce to the anatomical knowledge of the reader, to describe, or even to enumerate, these muscles. It is sufficient for our purpose to remark that the varying size, movements, and contour of the mouth and lips, and the oral orifice, all of which are of such vital importance in public speaking, singing, &c., result from the action of the various muscles placed around the lips, or rather constituting their substance, and those in connection with the lower jaw; all of which are admirably arranged and adapted for the accomplishment of the ends in view. The mouth and the lips, both separately and conjointly, can be gently or forcibly moved, opened or shut, and held in sundry positions, by the muscles in question, and can thus bestow various configurations on the buccal cavity, the lips, and the mouth.

The Lining Mucous Membrane of the mouth and lips covers in a large number of glands, the duty of which is the secretion of *mucus*, often mentioned already in connection with the mucous membrane of other parts, and designed to keep the membrane beneath which the glands are placed in a soft, moist, and pliable condition. The due secretion of this fluid, and its presence upon the membrane, is of the utmost possible importance, not only to the comfort of the person—and especially of the public speaker, the vocalist, &c.—but also to the proper delivery and correct pronunciation of words, and the clear enunciation of musical notes. How frequently is the truth of this statement exemplified in those who, from undue excitement at finding themselves unexpectedly addressing a public audience for the first time, find their tongues cleaving to the roofs of their mouths; both the tongue and the mouth, as well as the throat, being, owing to a temporary arrest of the secretion named, as dry and parched as if there had been a prolonged play upon the parts of a hot-air blast! The utterances are in reality almost unintelligible to the auditory; and the speaker knows the reason of his inability to form his words properly, as is seen by the incessant applications he makes to the contents of a glass tumbler, considerately placed near him, as a remedy for his affliction, by some thoughtful and kind-hearted brother!

Besides the glands here alluded to, which are of comparatively small size, there are others of great bulk situated altogether outside the mouth, but opening into it by means of special ducts or channels, by which they discharge their secretions into this cavity. These larger glands are respectively named—

The parotid gland;
The sub-maxillary gland; and
The sub-lingual gland.

They are all concerned in the secretion of the saliva, so plentifully poured forth into the mouth during the mastication of food, &c.

(*a.*) *The Parotid Gland.*—This is the largest of the three. It is placed below and in front of the ear, extending on the side of the face, and deep down behind part of the lower jaw. The duct carrying the secretion from it passes off from its anterior border, and pursues its course thence, forwards, over the upright portion (the *ramus*) of the lower jaw, till it reaches the front border of the *masseter muscle* (one of the muscles that raises the lower jaw); when it turns inwards towards the mouth, and after running a little forwards, it opens into this cavity, opposite the crown of the second molar tooth of the upper jaw.

(*b.*) *The Sub-maxillary Gland* occupies a space immediately below the base, and the inner surface of, the lower jaw. Its duct opens into the mouth in front, beneath the tongue, near the middle line, and close to its fellow duct of the opposite side.

(*c.*) *The Sub-lingual Gland*, the smallest of the three, lies along the floor of the mouth, between the tongue and the gums of the lower jaw, producing in that situation an elevated ridge, readily felt by the finger or the tip of the tongue. It discharges its secretion by ten or twenty separate orifices, opening upon the summit of the ridge just mentioned.

The Lips are, as everybody knows, very freely moveable in every direction, and their importance in this respect is very considerable, but especially as regards their use in the articulation and the correct pronunciation of words, in which particulars they stand on an equality with, and, in the sounding of some letters and words, even surpass, the tongue. What are termed the *labial* sounds (from Latin *labium*, "the lip") are dependent entirely upon the movements of the lips; as the letters *b*, *v*, *p*, not one of which can be correctly sounded—or, indeed, articulated at all—without the special agency of the lips. Moreover, sounds that are not strictly labial in character, as *o*, *m*, &c., cannot be correctly pronounced without the help of the lips.

It would be out of place in a production like the present, to enter at length into the question as to how the varying forms and arrangements which the lips are capable of assuming, serve as indices to the inward bias and predominant workings of a person's mind. But it may be allowable, perhaps, to point out that there is a language printed upon the lips as well as in the eyes, and that the former may be read almost as well, if not quite as well, and as intelligibly, as the latter. One or other (or more than one) of the many different expressions printed by the mind upon the face of an individual becomes in time indelibly stamped upon that face, each stamp carrying with it an interpretation peculiar to itself, as all *stamps* employed in the arts do, and which is more or less characteristic of the constant workings of the mind which originated it. By reading these facial stamps or imprints we may almost invariably form a pretty correct idea of the mental character of the person in whom we are for the time being interested, the stamp of mental individuality being imprinted upon his visage. How frequently do we, for example, intuitively, and quite unconsciously, pass a private mental opinion upon the personal character of a man or woman—or, rather, upon his or her presiding mental feelings or sentiments—by a glance at the passing face? Now, one of the most readable of these indices to the character of the mind is—not even excepting the eyes—the mouth, or the manner in which the lips are set. Habitual sorrow or disappointment produces, as we readily learn, a depression at the corners or angles of the mouth. Joy or pleasure, on the contrary, raises and draws in the angles; and where determination and firmness are the predominant characteristics, we find the lips in a more or less chronic state of contraction, and pressed together with more than customary firmness. Again, in the habitually calm and contented, and the even, unruffled-minded, whose lives are, in the main, smooth and happy, and passed in rosy serenity, how placid-looking are the lips! One resting upon the other with a charm peculiarly their own! Like the mind, which governs their expression, they are at ease—they rest in peace, and there is no spasmodic twitch or ruffle to disturb the enchanting picture they make! And do we not recognise the *sensual mouth*,—the mouth owned by the habitual rogue and vagabond,—the *sulky mouth*, &c.?

In this strain we might long continue, carrying our remarks into questions and subjects quite foreign to our present intentions, and discourse on the multifarious and almost characteristic forms assumed by the lips in speaking the languages of different nations, &c. It has been remarked, for example, that the varying contour assumed by the lips of a French lady speaking her own vivacious language, is generally a picture of quite a fascinating kind, and one expressive of charming simplicity and innocence. We have, however, already transgressed sufficiently, and will return therefore, at once, to more legitimate subject-matter.

CHAPTER XV.

THE TONGUE.

THE tongue is a most important body, from whatever aspect we consider it. Besides being an indispensable assistant to the teeth in the mastication of food—bringing, as it does, the chewed matter within the crushing power of the latter instruments; pushing it from side to side of the mouth; turning it over and over, and again and again placing it in the proper situation for the due accomplishment of the masticatory process; and, with the help of the cheeks, finally passing it backwards towards the top of the throat—it is one of the most necessary organs in the body for the articulation of words, and, therefore, for the inestimable treasure of vocal language and quick personal conversation. It is, moreover, the seat of the sense of taste, in addition to ordinary sensation.

In structure it is almost entirely muscular, and some of the muscles entering into its constitution have already been more than once described in connection with the laryngeal muscular system (see p. 65, &c., and Fig. 15). It is sufficient in this place to remark that the muscles are numerous, and that the direction taken by the fibres of each, within the substance of the organ, are so definite, that we can readily account for the great number and decided definiteness of its movements, as well as the many changes of form of which it is susceptible.

Its mucous membrane, which covers and entirely surrounds it, is derived from that lining the mouth. Beneath the tongue, in front, and in the middle line, the membrane is seen to become very prominent, forming a fold there, termed *the frænum*, which, when too highly developed, and when found to bind the tip of the tongue more or less abnormally to the floor of the mouth—as is often met with in new-born infants, —produces the condition termed *tongue-tie*, an abnormality which renders necessary a small operative procedure for its cure, or the child will not be able to suck properly, and, when grown up, capable of correct pronunciation or articulation of words. Beneath the membrane lie numbers of *glands* and *follicles*, designed for the secretion of the mucus, already and on several occasions brought under the reader's notice.

In Fig. 15, the relative position of the tongue is depicted, with regard to the larynx and other immediate parts, and the muscular connections and constitution (in part) of the organ.

To enter into the question, even in a cursory manner, of the formation of letters or articulate language, by the varying movements, contour, and positions of the tongue and lips, would entail upon the reader a mass of matter altogether foreign to the object of the task which we originally set ourselves to perform, besides inflicting upon him much that is of no interest whatever to the majority of people. We will, therefore, simply reiterate the general statement, that the tongue and lips are the most indispensable of all the secondary parts concerned in the articulation of words; that the *tone* must, as we have learnt, be first produced *in the larynx*, and subsequently variously modified and acted upon by the organs or structures along which, or through which, it has to pass; and that of these modifying agencies none is of such vital importance as the tongue and the lips. Without these, indeed, not a single letter in the whole alphabet is capable of being articulated or pronounced.

CHAPTER XVI.

THE TEETH.

THE teeth—the primary use of which is for the mastication of food, but which are also of more than ordinary interest in connection with our special subject—are embedded in what is termed the *alveolar ridge* of the jaw-bones. Their number in the adult is thirty-two—sixteen in each jaw. Two sets are supplied to the human species, termed respectively the *temporary teeth* and the *permanent teeth;* the former, known also as the *milk teeth*, numbering twenty in all—ten in each jaw.

The teeth, whether temporary or permanent, receive certain distinguishing names, according to the shape or form of their free ends (termed the *crown* of the tooth), and they are hence divisible into the following classes, namely:—

INCISORS, CANINES, and MOLARS,

for the temporary set; and

INCISORS, BI-CUSPIDS, and
CANINES, MOLARS,

for the permanent set.

The Incisors (or "Cutters") have the free end bevelled off posteriorly, so as to leave a sharp cutting edge (hence their name) in front, adapted for cutting or biting in two any suitable article of food. They are placed directly in front of the mouth, and are eight in number, four above and four below. They are the teeth which first make their appearance in the child, those growing from the centre of the gums (*the central incisors*) coming out first, at about the seventh month. The *lateral* incisors appear at about the ninth month. At the age of seven or eight years they all give place to the permanent incisors; the central teeth again taking precedence of the lateral, in this case by about a year.

The Canines are four in number, two in each jaw—one at each side, adjoining and coming next behind the corresponding lateral incisor. The *crown* is thick, and rounded off into a conical point. The canines are adapted for seizing, holding, and tearing. They are but elementary in man; but in some of the lower animals, and especially in the *carnivora*, as the lion, tiger, &c., they attain to their full development, and are then of great size and strength, far surpassing in these respects any of the other teeth. (See Fig. 21.) In the

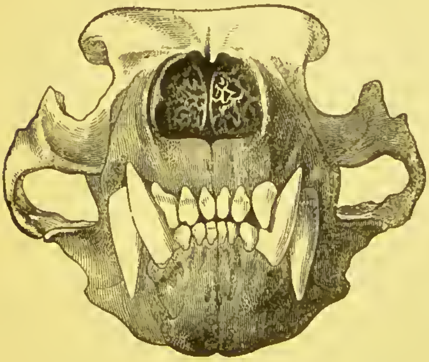


FIG. 21.

THE JAWS AND FRONT TEETH OF THE POLAR BEAR, showing the great size of the canines.

child, the canines appear at about one and a-half years old, and become supplanted by the permanent canines at about the eleventh or twelfth year.

The Bi-cuspids.—These appear in the adult only. The part of the gums filled by the bi-cuspids in the adult are in children occupied by the molars. When these molars in the child are cast out at the ninth or tenth year, their place is taken up by others of a different make and character; and they change their names accordingly. They receive their designation from being provided with two pointed tubercles or *cusps* on the free end of the crown. There are four bi-cuspids in each jaw—that is, eight altogether, two at each side—and they are placed next behind the canines. They assist the molar teeth in crushing and grinding the food.

The Molars.—These are the grinding teeth proper, and in man are the strongest of the whole set. They are twelve in number—six in each jaw, three at each side; and their position in the mouth is the most posterior of all the teeth. They are distinguished, according to the order in which they are placed from before backwards, as First, Second, or Third Molars. The grinding surface of the upper molars is provided with four raised cusps, the lower molars with five. The molars are supplied but once to the human species, that is, they are *primarily* permanent teeth, having had no predecessors on the ground which they occupy. They differ in the order of their appearance, this order being as follows:—

The first molars appear at about the 6th year.
„ second „ „ „ 12th to 13th year.
„ third „ „ „ about 24th year.

The third molars are known also as *wisdom teeth*, from their not appearing till the arrival of years of discretion; and the time of their eruption varies considerably in different persons.

The following tables may prove useful for reference. They give much information in a small space :—

TABLE I.

Showing the Relative Arrangements or Positions of both Sets of Teeth, the Names and Numbers of each kind, and the Relation of Number subsisting between the Two Sets.

Temporary Set.

	Molars.	Canines.	Incisors.	Canines.	Molars.		
Upper............	2	1	4	1	2	= 10	20
Lower	2	1	4	1	2	= 10	

Permanent Set.

	Molars.	Bi-cuspids.	Canines.	Incisors.	Canines.	Bi-cuspids.	Molars.		
Upper	3	2	1	4	1	2	3	=16	32
Lower	3	2	1	4	1	2	3	=16	

It will be seen from the above table that the teeth which, as temporary teeth are termed molars, become in the adult "bi-cuspids," and that the *permanent* molars are an entirely new addition, occupying entirely new ground.

TABLE II.

Showing the Order of Eruption of the Temporary Teeth.

Name.	Molars.		Canines.	Incisors.		Canines.	Molars.		Name.
Months.	24	12	18	9-7	7-9	18	12	24	Months.

The above may be read thus :—The central incisors appear at the 7th month; the lateral incisors at the 9th month. The canines at the 18th month. The molars—anterior at the 12th, and the posterior at the 24th month.

TABLE III.

Showing the Order of Eruption of the Permanent Set of Teeth.

The First Molars appear at about the 6th year.		
The Incisors (Central)	do.	7th ,,
The Incisors (Lateral)	do.	8th ,,
The Bi-cuspids (Anterior)	do.	9th ,,
The Bi-cuspids (Posterior)	do.	10th ,,
The Canines	do.	11th to 12th year.
The Second Molars	do.	12th to 13th ,,
The Third Molars	do.	17th to 27th ,,

That the teeth are of the greatest assistance, and even in some cases indispensable to, correct pronunciation, a moment's consideration will show. It is also of importance that they should be sound in structure, and perfect in number and arrangement. In the absence of two or three teeth, or even of one, if the loss be in front, it is extremely difficult, and occasionally impossible, to articulate or pronounce certain words with any near approach to distinctness; the defect of certain front teeth resulting in a hissing sound—that is, in the sounding of the letter *s*, with more or less exaggeration, wherever it occurs in a word, and sometimes when it is not present. In other cases a *lisp* is produced, giving one the impression that the subject is tongue-tied. So, too, with regard to unsound, decayed, and broken teeth; or where these, though sound and whole, are too loosely set, or too much crushed or squeezed together, the pronunciation of words is sure to be prejudicially affected, the result being indistinctness and harshness of sound.

From the preceding considerations, it is scarcely necessary to impress upon the reader the advantage of paying careful attention to the condition of his dental system, and more especially if his calling be one which necessitates his speaking in public, or which takes him on the platform as a vocalist, &c. Every one placed in such circumstances desires, of course, to do his best to be effective; but his efforts are always attended with great disadvantage if, from certain defects in his dental system, he cannot pronounce his words clearly and distinctly.

CHAPTER XVII.

THE NOSE AND ITS CAVITIES.

IN discussing the nose and its cavities, it will be to our advantage if we take the latter first.

The cavities of the *nares*, or nostrils, are the hollows lying between the nostrils externally and the top of the pharynx internally. *The floor* is formed by the structures which constitute the roof of the mouth. *The roof* is sloping in front and at the back, but flat in the middle third. It is somewhat irregular in contour, and the parts of four separate bones go to make it. The partition between the two cavities, and which runs from before backwards, divides into two, what would otherwise be but one, cavity, and is constituted principally of the bony plates, respectively termed *the ethmoid bone* and *the vomer*. The division is completed in front by a cartilage named the *septal cartilage*. The *external walls*, or boundaries, are extremely irregular in contour; an arrangement which, as we shall see presently, is plainly designed to increase the superficies of the internal cavity. One or two of the bones which enter into the formation of the *nares* are found to be curled or twisted upon themselves,—like certain fancy shells seen in bazaars, &c.,—and they likewise project considerably inwards towards the middle line, or septum, and leave depressions or passages along these outer walls, from before backwards, through which air, when inhaled by the nostrils, may make its way inwards. Each of the passages thus formed is termed a *meatus;* and of these there are three at each side—the *superior*, *middle*, and *inferior meatus*, respectively.

The *superior meatus* (*a*, Fig. 22) is the shortest of the three. The *middle meatus* is indicated by the letter *b;* and the *inferior meatus* by *c.* The latter is the longest, the straightest, and has the most irregular walls of the whole three. Its floor is formed by the upper surface of the hard palate, as shown in the figure (Fig. 22).

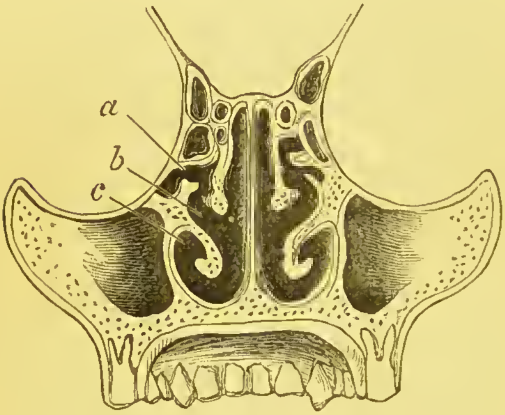


FIG. 22.

VIEW OF THE NASAL PASSAGES FROM BEHIND.

(*a*) Superior Meatus; (*b*) Middle, and (*c*) Inferior Meatus.

In front, the cavities of the *nares* are completed by the *bones and cartilages of the nose.*

The Bones, termed the *nasal bones*, are four in number, two belonging exclusively to the nose, and forming *the bridge*, while the rest are merely projections from the upper jaw.

The Nasal Cartilages are what give shape, form, and *stiffness* to the soft parts of the nose, keeping the nostrils open, so as to allow free admission and exit of air during respiration. They are eleven in number, five at each side, and one in the centre, the latter forming the tip of the nose, and the most anterior part of the septum, or antero-posterior division of the nostrils. The relative sizes, positions, and shapes of the cartilages, and also of the nasal bones, will be best understood by reference to the annexed figure (Fig. 23). By means of their attached muscles the cartilages are slightly movable upon one another, though the power at command is generally very small. In children, however, the mobility is much greater; and in certain diseases within the chest the cartilages act with great freedom, the nostrils alternately dilating and closing with marked vigour to an abnormal extent. The lining mucous membrane of the *nares* is termed

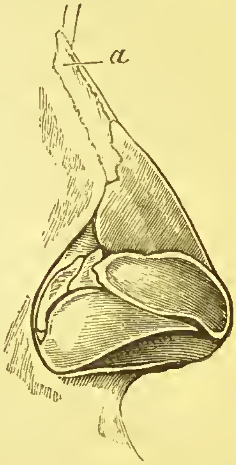


FIG. 23.

SIDE VIEW OF THE NASAL CARTILAGES, AND OF THE NASAL BONES.

(*a*) The nasal bone, right side, showing also right edge of left. Below are the nasal cartilages.

The Schneiderian Membrane.—This is highly vascular; that is, it is abundantly supplied with blood-vessels. It follows and clothes all the twisted ("turbinated") bones previously mentioned, and all the irregularities and sinuosities of the nasal cavities; and its presence within these cavities is of the highest possible importance in many ways, as we shall see in the following chapter, when treating of the common respirator.

The cavities of the nares, besides possessing certain qualifications, to be presently described, have other important uses and properties. Not to mention the different forms of the nose, by which various and characteristic physiognomies are implanted upon the human countenance, we find them modifying, to a remarkable degree, the tones of the voice, in which latter respect they play, indeed, a most striking part. For the vast proportion of spoken words do not, as we should hastily imagine, issue from the mouth only. They pass also through the nasal passages, and out by the external nostrils. Such letters as *m*, *n*, and the words in which they are sounded, cannot be properly pronounced without the help of the nose and its passages; and the indistinctness or modification attending the articulation of words not strictly nasal, can readily be made apparent to the reader by his repeating aloud a few lines from any common book or newspaper while his nostrils are kept firmly closed by his thumb and fore-finger,—an act which is simply imitating the effects of a bad cold, when the lining membrane of the nasal passages is so much swollen as to occlude, more or less completely, the passages from the top of the pharynx to the external openings of the nostrils. Some languages have this nasal tone much more strongly marked than others. The French language, for example, is one which is pre-eminently distinguished by the free use of the nose and its passages; but in all nations the nasal tone exercises, in a greater or less degree, a modifying influence upon the language, and gives more or less character to it. "The chief distinction of the sounds of speech is according as they are transmitted through the oral canal or the nasal passage."

CHAPTER XVIII.

THE COMMON RESPIRATOR.

THE common respirator is designed, primarily, to act as a warming apparatus to the air passing to the lungs, through the cavity *of the mouth*, and consists essentially of meshes or network of wire, made of some incorrodible metal, as silver, platinum, gold, &c., placed within a frame of convenient size and suitable shape for fixing in front of the lips; the contrivance being kept in position by two elastic strings, passing one from each end of the frame, and then, by means of a loop, round the corresponding

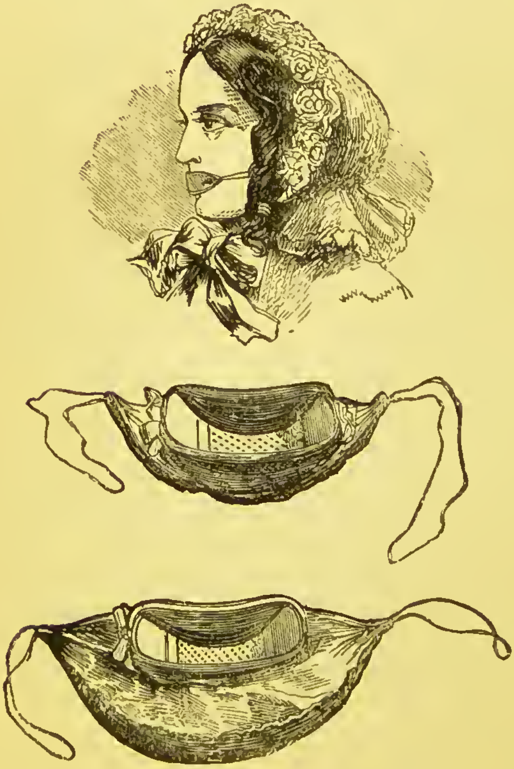


FIG. 24.

THE COMMON RESPIRATOR, AS WORN.

ear of the wearer. The outer surface is covered generally with fine silk, which, besides giving neatness and protection to the instrument, acts also as a kind of filter to the incoming air, depriving the latter, to a great extent, of its floating solid particles.

We have said that the respirator is designed to warm the air passing to the lungs through the cavity of the mouth; but before it can communicate, and afterwards *continue* to communicate, warmth to the air that is being inspired, the instrument must have not only its temperature at the outset raised above that of the air, but the wires must afterwards be *maintained* at a higher temperature. The first increase is given by placing the respirator for a moment or two before the fire, &c., and the temperature is afterwards kept up by the warmth of the *ex*pired air as it makes its way through the wire meshes, and also, but in a less degree, by that of the lips, close to which the instrument is worn. The explanation of the mode of action of this small but scientific contrivance is thus very simple, and is easily understood. The wires, through the meshes of which the air must pass on its journey to and from the lungs, being made of one of the metals, and the latter being the best conductors of heat, are highly susceptible to changes of temperature,—quickly receiving an increase from any body of a higher temperature than themselves when placed near or in contact with it, and as quickly parting with it to a cooler body under similar conditions. When, therefore, the respirator is at a higher temperature than the air to be inspired, the former parts with heat to the latter as it makes its way through the wires,—these dividing and splitting up the stream into innumerable portions of exceeding fineness, and thus proportionately increasing the extent of surface to be acted upon. The respirator being now reduced in temperature, and the air about to be expired being warmer than the wires, these now quickly abstract warmth from the former as it passes outwards,—an act which again places the respirator in a condition for imparting warmth to the succeeding incoming stream of cooler air during the next act of inspiration. This behaviour of the respirator in first parting with warmth to the cooler air of *in*spiration, and then, on being itself lowered in temperature, as quickly taking warmth from the air of *ex*piration, and so being in a condition for again acting upon the incoming stream, is but the work of a moment, or the time occupied by one respiratory act; and in this speedy adaptation to varying temperatures lies the value of the instrument. The whole process of first quickly receiving warmth, and then as suddenly parting with it to the cold air, as the latter passes inwards, is, indeed, brevity itself; and were it otherwise, the contrivance would be almost, if not altogether, useless for the end in view.

For the passage of air *through the nose*, special means are adopted by nature, by which the nasal channels are of themselves capable of communicating warmth to the cold air as it makes its way through them into the body; and here, therefore, artificial contrivances for accomplishing this purpose become, under ordinary circumstances, quite unnecessary. The manner in which this is effected is very beautiful and highly interesting. In the first place, the contour of the nasal passages is, as we have seen, *very irregular*, —an arrangement which tends to impede the progress of the stream of incoming air, and thus to give it more time to become warmed by contact with the parts entering into the formation of the passages,—the stream striking upon the angular bendings, as water does upon the banks of a winding channel, instead of passing on directly to the back of the throat almost unacted upon. Second, the external walls or boundaries of the nasal passages are also distinguished by their irregularity, and to a most marked extent are they so. One or two of the bones which help to form these boundaries are, as before stated, actually curled or twisted upon themselves,—the curled portions, moreover, being found to project considerably inwards towards the middle line of the channels, so as to become entirely surrounded by the passing stream of air, something like the bends and projections occasionally observed in certain kinds of boilers for economising the heat generated from coal,—and by such means a very striking increase in the warming surface is, of course, imparted to the channels. And, thirdly, the lining membrane, or skin, of the nasal passages is, as we saw, exceedingly vascular,—or more than ordinarily supplied with blood-vessels, the importance of which will be shown presently; and this membrane follows and clothes, as we learnt, all the peculiar convolutions of the twisted bones just spoken of, besides passing and insinuating itself into the various cavities and depressions found in many parts of these channels. It is to be observed, moreover, that that portion of the membrane which clothes the curled and twisted bones is of unusual thickness, and even still more abundantly supplied with blood than that in other parts of the passage. Another peculiarity found here, and which still further conduces to the warming efficiency of the nasal passages, consists in the lining membrane,—instead of being simply in close opposition with the convoluted portions of the bones, as in other parts of the channels,—being so thickly supplied to these curled-up portions, that it actually projects to a considerable extent inwards from the bony prominences, by which a still further increase in the superficies of the warming apparatus within the nasal cavities is effected.

The result of all these manifold arrangements—and which latter cannot but fill the mind with wondering feelings of admiration—is an extensive and beautiful natural heating contrivance within the cavities of the nose, for warming the stream of cold air which passes in that way, and thus providing the delicate structure of the lungs with this essential of life at a temperature best suited for these organs, and therefore reducing to a minimum the risk of setting up in them, or in their delicate network of breathing tubes, certain inflammatory attacks, which are so prone to follow exposure to cold, nipping, and therefore irritating, air.

Another striking circumstance in the anatomical construction of the nasal passages, and which should, perhaps, have been mentioned before, is, that the inferior channels, through which the atmospheric air has the greatest tendency to pass, and to pass, moreover, in the largest volume, and at the greatest speed, are just those passages which are the most carefully attended to as regards the warming arrangements; for in these is found the greatest irregularity of construction, and a special abundance of highly vascular membrane, coating, and projecting from, these irregularities. With reference to the latter provision, it is perhaps necessary to state that the higher the vascularity of a part, the greater, *cæteris paribus*, is its power of withstanding the contact of cold, and the more capable is it of supplying warmth to matter of a lower temperature than itself; and these are, we have seen, the very conditions found here, and found here in the greatest perfection. The dividing or partitioning of the nasal passages into channels of comparative narrowness, by projections of such great irregularity, correspondingly breaks up the incoming stream of air into thin layers or portions, instead of permitting it to pass down into the lungs in one unbroken, and, therefore, comparatively unwarmed, volume; the stream being thinly spread out, and effectually divided, its superficies is proportionately increased in extent, and it becomes all the more readily adapted for being speedily acted upon by the warmth of the dividing media, during its brief contact with them.

Within the cavity of the mouth there exists no such mechanical conformations, or any other specially contrived means for warming the incoming current of cold air; and for the simple reason that, as a respiratory channel, the mouth was designed for *occasional* use only,—as, for example, when the nasal passages become more or less occluded by attacks of cold, &c. And it is only in such circumstances, and on rare special occasions, or where conversation out-of-doors, or in a cold atmosphere, cannot be dispensed with, that the respirator need be worn at all. If the individual, at such times as the last named—that is, while in a cold atmosphere—would only remember to keep his mouth closed, and to carry on respiration through the nostrils only, he could entirely dispense with the respirator, as far as its *warming* qualities are concerned,—these latter being the chief, if not the only, reasons for wearing the instrument at all. There is nothing magical in the operation of the little contrivance. It does not confer upon a delicate constitution any increase of stamina, or any extra vital power. It simply—though this must be acknowledged to be a good deal—takes off the chill and *biting* character of cold, frosty air, and thus fits the latter for safely coming in contact with the delicate mechanism of the lungs,—these organs being generally, in those who most commonly wear the respirator, in a low condition of vitality, and more or less diseased, and, therefore, more than usually prone to take on inflammatory or other serious actions.

It has been already stated that, by virtue of its external covering of fine silk, the instrument acts also as a kind of filter, in depriving the air of inspiration of numerous floating mechanical impurities, and which, but for this protection to the mouth, would find their way into the breathing tubes, and thus work, or have a tendency to work, mischief in another way besides that consequent upon mere coldness of the air; and it might, therefore, be supposed that the mouth is, as far, at any rate, as this point is concerned, placed in a better position when protected by a respirator, which excludes these irritating particles of matter, than the unprotected nasal passages. There can be no doubt that much floating matter which, if allowed to find its way to the delicate tissues of the lungs, would more or less prove injurious to these organs, is, by the simple means in question, prevented from thus gaining admission—that is, by the mouth; but it must be remembered that these matters could *not* effect their entrance by the mouth if this cavity were simply kept closed by the lips. However, for the protection of the nasal passages, there exists naturally what may for practical purposes be regarded as a special provision for accomplishing the very same ends—the presence, namely, upon the surface of the lining membrane of these channels of a viscid, tenacious fluid, secreted by the membrane, or, rather, by certain special glands situated beneath it, and opening by their mouths upon its free surface. This secretion—which, except in certain diseased conditions of the passages,—is without intermission found lubricating the membrane, effectually arrests and fixes upon it such floating matter coming in with the inspiratory stream as comes in contact with it; and, as the amount of surface which is freely exposed to the passing stream is, as we have seen, very considerable, the major quantity of material intercepted by the secretion must likewise be efficiently drained and separated from it, and with the immediate and beneficial result of furnishing to the respiratory tubes comparatively pure air. That the amount of obnoxious matter in this way arrested, and deposited on the lining membrane, is often very large, is repeatedly made evident to our sight, and especially when a dusty atmosphere is prevailing, by the character of the ejected secretion, which is often so deeply tinged, or rather impregnated, with the dust inhaled that, as far as its colour is concerned, it cannot readily be distinguished from the dust itself;—colliers, for example, foundry-men, and similar classes of work-people frequently ejecting the dust-laden secretion from their nostrils, &c., as black as the coals or the pulverised material amongst which their living is made.

As, however, it is often found impossible or extremely inconvenient to respire through the nostrils only, the respirator here steps in, and proves itself in such circumstances a most handy, useful, and effectual safeguard,—beneficially modifying the physical character of the inspired air, both by the warmth imparted to it and by its power of depriving it of many mechanical irritating impurities. It is inexpensive; its application, as everybody knows, is simplicity itself; it occupies so small a compass that, when temporarily removed from the lips, it can be conveniently and instantly placed in the pocket; and it cannot get out of order, or easily lose the smallest part of its efficiency.

For these and other, but minor, reasons, we cannot but look upon it as a real friend, whose acquaintance no one need feel chary about, and which no one will ever find occasion to deplore. And this remark applies with particular force to those who, like ministers of religion, vocalists, &c., have occasion to use freely their vocal organs, and have habitually to leave close and heated rooms for the cold air of the streets.

CHAPTER XIX.

THE BLOOD SUPPLY OF THE VOCAL ORGANS AND CONNECTED PARTS.

HITHERTO we have been principally engaged in describing the anatomical characteristics and physiological actions of the organs of vocalisation,—so far, at any rate, as the description concerns their vocal bearings. But nothing has yet been said respecting the blood supply of these organs, on which their integrity and very life depend. And as their proper consideration would be very incomplete without a few, at least, of the leading facts on this question being stated, we will now proceed to add, as briefly as the subject will admit, a few observations on this matter.

The centre of the circulatory system (or that concerned in the carrying to and fro of the blood of the body) is, as most people know, the heart,—a large, hollow, muscular organ, situated within the cavity of the chest, between the two lungs, just behind the breast-bone. The heart is the original and primary motive power by which the blood is propelled to every part of the body. It is the *engine*, so to speak, which keeps up the circulation of that fluid ; first pumping it to the extreme parts of the system, and then, after its purposes have been there fulfilled, receiving it back within its cavities, that it may again send it forth on its wonderful life-giving mission.

From the upper broad end of the heart are given off the large arterial vessels (see Fig. 25), which, with their branches and subdivisions, carry the stream of blood to every corner of the animal economy. Here, too, are placed the venous blood-vessels, or the channels through which the blood is ultimately returned to the heart (*a a*, Fig. 25). The heart is divided in-

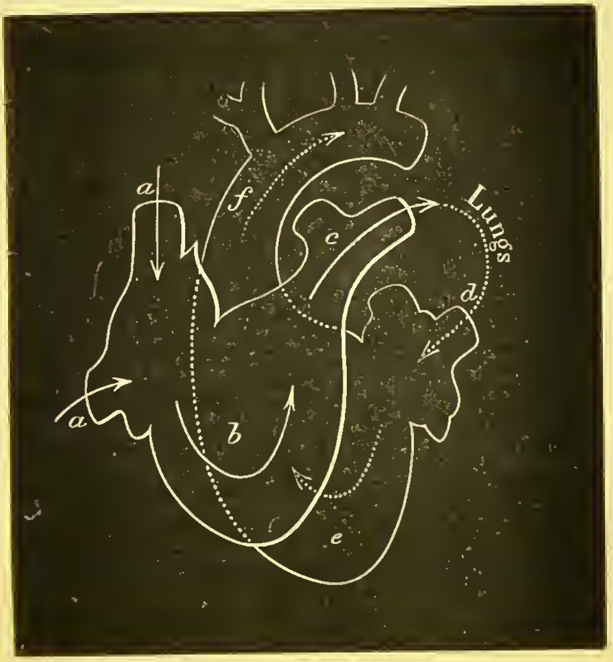


Fig. 25.

Diagram of the Circulation of Blood through the Heart.

The course taken by the blood is indicated by the arrows.

(*a a*) The openings through which the venous blood enters the heart; (*b*) Right ventricle; (*d*) Entrance to left auricle; (*e*) Left ventricle; (*f*) The aorta, with the origin of some of its main branches.

ternally into four cavities. Those two from which the blood is propelled into the arteries are termed *the ventricles*,—right or left (*b* and *e*, Fig. 25), according to the side of the organ on which they are located; and the two cavities which receive back the blood, and afterwards force it into the ventricles, are termed respectively the right and left *auricles* (between *a* and *b*, and *d* and *e*, Fig 25).

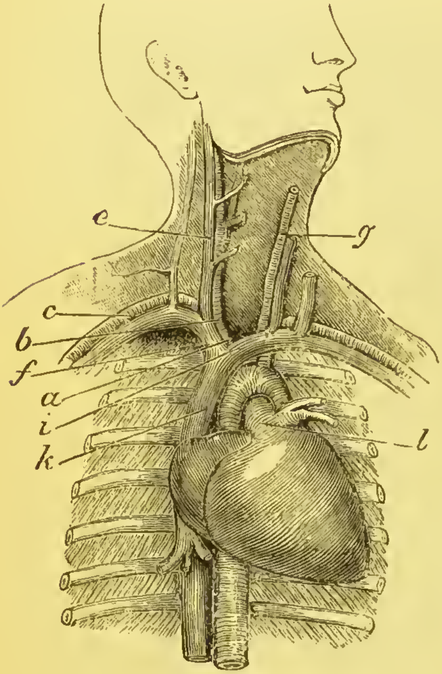


FIG. 26.

THE HEART *in situ*, SHOWING CHIEF BRANCHES OF AORTA.

(*a*) The innominate artery; (*b*) Common carotid; (*c*) Sub-clavian; (*g*) Left common carotid.

The main arterial trunk arises from the left ventricle, and is termed *the aorta* (*f*, Fig. 25), and which, from being bent at a short distance from its origin into the form of an arch, is there termed the *arch of the aorta.* It is from this part that the arterial trunk arises which, by its division and subdivision, supplies blood to the larynx and to the structures in its immediate vicinity.

In the annexed figure (Fig. 26) is given a rough representation of the centre of the circulation, with the main branches, arterial and venous, in its immediate neighbourhood. On the right side arises the first and largest branch from the aorta, termed the *innominate artery* (*a*; see also Fig. 25, the branch above *f*), and which, at a point behind the junction of the breastbone with the collar-bone, divides into two trunks (*b*, Fig. 26, and the division of branch immediately above *f* in Fig. 25). One of these trunks is the *sub-clavian artery* (*c*, Fig. 26), which passes across the base of the neck, to supply the right arm, &c.; and the other is the *right common carotid artery* (*e*), which ascends the neck for the supply of the structures of this neighbourhood, and also the head, &c. The lower part of the innominate artery, near its commencement, crosses the main windpipe; and this is a fact of some importance, and to be borne in mind by the medical man in connection with certain diseases affecting the vocal apparatus. The vessel *f* (Fig. 26), seen to cover partly the innominate artery, is the *innominate vein*, which is formed by the *right sub-clavian vein* (shown below the corresponding artery), and the *internal jugular vein*, seen running down by the side of the common carotid artery (Fig. 26).

On the left side, there is no innominate artery, as each of the arteries into which, on the right side the innominate artery divides, here arises *directly* from the aorta, as shown in Fig. 25, at the very top of the figure.

The branches of both the sub-clavian and the carotid arteries are devoted to the blood supply of the vocal apparatus, though the branches of the carotids constitute the chief supply.

The common carotid artery supplies no *branches*;

but it divides into two trunks, just opposite the upper border of the thyroid cartilage, termed respectively the *external* and *internal carotid arteries*, according to the chief destination of their blood to the *outer*, or the *deeper*, part of the head, &c. And it is mainly from the branches of the external carotid artery that the organs of the voice derive their supply of blood. In the accompanying figure (Fig. 27), the letter *a* points

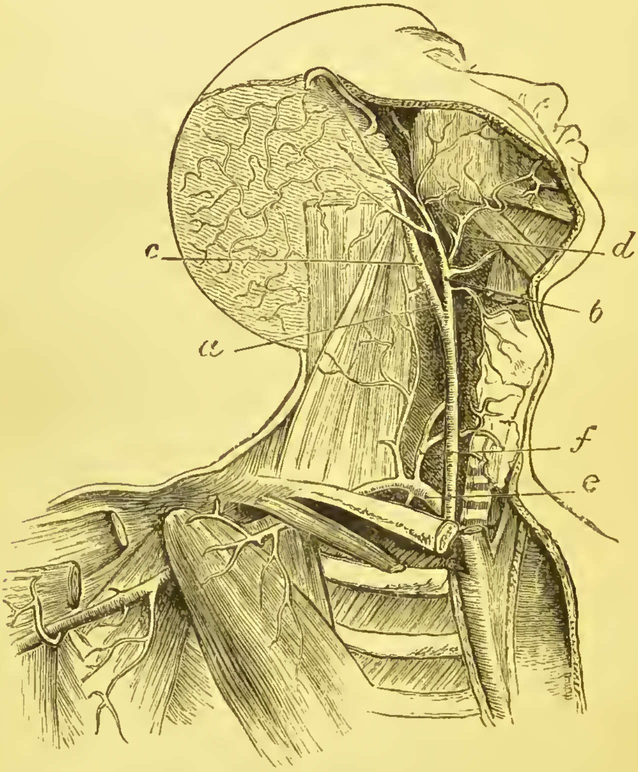


FIG. 27.

VIEW OF THE SUPERFICIAL BLOOD SUPPLY OF THE NECK AND FACE, &C.

(*a*) Common carotid artery, dividing into the external (*b*), and the internal (*c*), carotids; (*d*) The facial artery; (*e*) The sub-clavian; (*f*) Inferior thyroid artery.

to the common carotid artery, just at its point of division into the external (*b*) and the internal (*c*) carotids. And the general direction taken by the branches of the external carotid is also shown in the figure, as well as those of the sub-clavian artery, and the continuation of this down the arm. The branch seen immediately below the line from *b* is the *superior thyroid artery*, and that above it the *lingual artery*,—the former supplies chiefly the thyroid gland and the larynx, and the latter the tongue. Immediately above the lingual artery is seen the *facial artery* (*d*), making its way towards the angle of the mouth, for the supply of the face, &c. Each of the branches just named gives off numerous other smaller branches, the larger of which receive special names; and they all freely ramify upon, and supply blood to, the parts immediately adjoining. Other branches are seen to ascend to the upper and posterior parts of the neck and the head, and these receive names according to the part which they principally supply.

At *e* (Fig. 27) is shown the *sub-clavian artery*, giving off numerous off-sets, and passing outwards and downwards, beneath the collar-bone, for the supply of the arm, the side of the chest, &c.

The branch marked *f* is the *inferior thyroid artery*, which is seen to ramify upon the thyroid gland. By smaller branches, it also supplies the muscles and the mucous membrane of the larynx, the gullet, the main windpipe, &c.

The blood-supply to the interior of the chest is derived from branches of the *thoracic aorta* (see *m*, Fig. 26)—that is, from that part which descends the thorax, and which is the continuation downwards of the arch of the aorta. The descending aorta lies upon the front of the spinal column or backbone, bending as the latter bends, and giving off the branches spoken of in its progress. These are named according to the parts which they principally supply with blood—as the *bronchial* arteries, or those for the bronchial tubes; the *æsophageal*, for the æsophagus or gullet; the *intercostal*, for the spaces between the ribs, and so on. Below the diaphragm branches are given off for the supply of this muscular partition.

The blood having been supplied to the various parts enumerated, and having there accomplished the purposes assigned to it by Nature, it has now to be returned to the heart, thence to the lungs, to be purified by the act of respiration, then back again to the left side of the heart, and finally to be once more sent on its vivifying round. The direction taken by the blood through the heart is shown in Fig. 25, p. 141. The vessels through which flows the blood back to the central organ of circulation are termed, as has been previously stated, *veins*,—the blood they carry being termed *venous blood*. The veins, in the majority of instances, may be said to lie side by side with the artery of the same name,—sometimes one vein, sometimes two, accompanying each artery. To this rule, however, there are exceptions, as in case of the external jugular vein, for example, which has no companion artery.

The blood of the head and neck, and of the arms and the thorax, having been collected by the different venous vessels, is ultimately poured into the right auricle of the heart by one great trunk or channel, termed the *superior vena cava* (the upper letter *a*, Fig. 25, and *k*, Fig. 26), which is formed by the union of the two main trunks of the right and left sides respectively, and termed the *brachio-cephalic*, or *innominate veins* (see Fig. 26, *i*); which, again, are formed by the joining of the two trunks that return the blood from the arm and the neck; and so on.

The Pulmonary Artery and Veins.—The arteries and veins that have been so far considered are the *nutrient* vessels of the various parts; those which are furnished to the lungs coming also under this category, and having nothing to do with the *aëration of the blood.* For this latter process a totally distinct set or system of vessels is provided, termed the pulmonary arteries and veins, whose sole duty is, respectively, the bringing of the impure venous blood into relation with the inspired air, and, after its purification by the latter, the collection and carrying back of this fluid to the heart.

The vessel which leads the venous blood from the heart to the lungs is termed the *pulmonary artery*, and which is a wide but short trunk, arising from the base of the right ventricle (*c*, Fig. 25, and *l*, Fig. 26), in front of the origin of the aorta. At the under aspect of the arch of the aorta, it divides into the trunks designed respectively for the right and left lung, hence called the right or left pulmonary artery. At the root of the lungs each of the arteries divides and subdivides into numberless roots and ramifications, which ultimately become reduced to extreme fineness. The *pulmonary veins* having received the purified and now scarlet-coloured blood by innumerable minute channels, these now converge into larger and larger trunks, until at last they pour their contents into the left auricle of the heart by four mouths—two from each lung ; thence the blood passes to the corresponding ventricle, then into the aorta, by which, and its branches, it is distributed, as we have already seen, to every part of the economy.

CHAPTER XX.

THE NERVE-SUPPLY OF THE VOCAL ORGANS, ETC.

THE great centre of the nervous system of the body is the brain and the spinal cord, collectively spoken of as the *cerebro-spinal axis;* and from one or other part of this come the strings of nervous matter, termed *the nerves* (which are, however, mere prolongations of this axis, strengthened and protected by areolar tissue), along whose length the influence of the central mass is made to travel. Just as in the case of the wires of the electric telegraph, for example, which act as the medium of communication between the central reservoir, where the power is originated, and the more or less distant parts of the system,—the nerves, or the wires, as the case may be, only *conveying* the power or influence, not *creating* it. The nervous force bears the same relation to the various operations and movements carried on within the animal economy as does steam to the steam-engine, for example, or electricity to the electric telegraph. So that, supposing it possible to dissect out, and take away from, the body of man, without destroying his life, all his nervous apparatus, he would be no better, so far as his power of personal locomotion, or of sensation, &c. were concerned, than a mere block of inanimate marble. Without the presence and peculiar action and influence within the body of the nervous system, there would be no faculty of sight, or of hearing, or feeling, or any other sensation. There would be no circulation of the blood, no respiration, mastication, &c. &c., and intelligible communication with the outer world would, of course, be altogether impossible. For, though the eyes, ears, &c., might be perfect as regards their mechanical construction and physical adaptability for the several ends which they were designed to fulfil, yet, stripped of the peculiar influence supplied by the nervous system, the organs would afford no response to the calls made upon them. They would be placed in a condition similar to that of a highly-finished and powerful steam-engine, for example. Though endowed with marvellous mechanical powers, these latter do not manifest themselves until the special energy of the engine—that is, *steam*—is brought to bear upon it. In the animal economy, movement and sensation require for their creation and expression, *nervous force*, just as the steam-engine requires steam, or the electric telegraph system requires the agency of electricity, for their respective actions.

The filaments of which the spinal nerves are composed are of two kinds—SENSORY and MOTOR ; the former conveying to the central axis the phenomena of sensation, as pain, heat, cold, &c., and the latter operating from within outwards upon the various muscles, glands, &c., and causing them to manifest their respective actions. At their origin from the spinal cord the nerves have each two *roots*, or points of exit, one (the *posterior*) being entirely sensory in function; and the other (the *anterior*) altogether motor in character. These two roots soon, however, unite, and form one indivisible nerve, which is hence termed a *mixed* or *compound* nerve, though it acts as if its two separate roots had remained distinct throughout; that is, it conveys sensation by its sensory filaments, and motor power by its motor filaments. A *sensory* nerve or fibre cannot convey *motor* power; moreover, the direction taken by the nervous force in a sensory filament is always from without inwards to the centre. On the contrary, *motor* fibres cannot pass *sensory* impressions along their course, nor nervous influence from without inwards, but always in the reverse way. Again, some nerves are neither sensory nor motor, in the sense just described, but possess a special and peculiar property of their own, and no other, as in the case of the olfactory nerve, for example, whose special function is to preside over the sense of smell; or of the auditory nerve, over that of hearing; and so on.

In the great majority of cases, the nervous power or force can, in regard to motor energy, be let loose from the central mass, and be made to travel along the nerve required, at the sweet will of the individual, as in all cases of voluntary movement, such as walking, &c. &c., where we have only *to will* that our lower limbs shall move, when, as quick as thought, the nervous power issues from the brain, passes down the spinal cord to the place at which the particular nerve which presides over the muscles we wish to set in action is reached, then along that nerve to its muscular distribution, when the muscle at once contracts or relaxes, according to our wish, and the required motion is performed. In some cases, we have no command over the action of a nerve, nor, in consequence, over the muscle or muscles to which that nerve is distributed; as in the case of the constrictor muscles of the pharynx, for instance, which, so soon as a morsel of food comes within their grasp, act upon it and force it downwards towards the stomach without any effort or wish of ours, and even in spite of any desire we may evince to the contrary. This behaviour of the constrictor muscles of the pharynx is an example of what is termed *reflex nervous action*, an expression that will be understood, perhaps, by the following illustration:—When the skin of the hand, &c., is pinched or pricked with a sharp instrument, as a needle, &c., the part thus operated upon is at once withdrawn from the source of irritation, not simply because we *willed* that this should be so, but quite independently of the will, and before the mind has had time to think about it. This involuntary movement is the result of the reflex action of the spinal cord, the sense of injury having passed along the sensory filaments of the nerves supplying the irritated spot to the spinal cord, whence it is at once *reflected*—like light from a polished surface; and, passing back by the motor filaments of the same nerve to the muscles of the part, these immediately contract, and thus draw away the hand from the place it previously occupied. In such cases as the foregoing, the nervous influence is said to be *reflected* or turned back, the action being altogether independent of the will. For the same phenomenon results when all communication with the brain is cut off, as when an animal, as a frog, &c., is decapitated. When, moreover, the irritation or pain is severe, the influence may not stop at the point of exit from the spinal cord of the nerve commanding the injured place, but it may pass further up to a part governing other nerves, along which latter the energy may then pass to a part of the system altogether different from that from which the irritation originally came, and then act upon that other part as if it had been the real original seat of injury. We have an instance of this when a crumb of bread accidentally finds its way into the larynx. Here, violent reflex movements at once ensue, causing energetic paroxysms of coughing, the irritation caused by the offending body having been reflected from the upper part of the cerebro-spinal axis to the muscles of the chest, the diaphragm, &c., which are, as a consequence, immediately thrown into action.

The nerves, like the arteries, of the vocal organs, and of connected parts, are named principally in accordance with their seat of distribution. And as regards function, some are *sensory*, some *motor*, and others, again, *compound*.

As in the case also of the blood-vessels, so here, we shall not inflict upon the reader a minute description, or give him a list even, of all the nerves that supply the vocal organs. It will suffice to call attention to the most important of them; and of these latter the principal, both as regards size and function, is—

The Pneumogastric Nerve ("The Nerve of the Lungs and Stomach").—The chief parts to which this long nerve is distributed are implied by its name; but it also sends branches to the organs of the voice, to the gullet, the heart, liver, spleen, &c. Its course, from the upper part of the spinal cord down to its termination at the stomach, and the most important branches given off by it, with their distribution, &c., are shown in the accompanying figure (Fig. 28). It descends the neck, lying between and behind the common carotid artery and the internal jugular vein. At the root of the neck the nerve of the *right side* passes over the corresponding sub-clavian artery, and here gives off that important branch, the *inferior laryngeal nerve*, which turns backward and sweeps beneath the vessel, to ascend to its destination in the larynx (3, Fig. 28). The pneumogastric then continues its journey behind the innominate vein, on the side of the trachea, to the back of the root of the

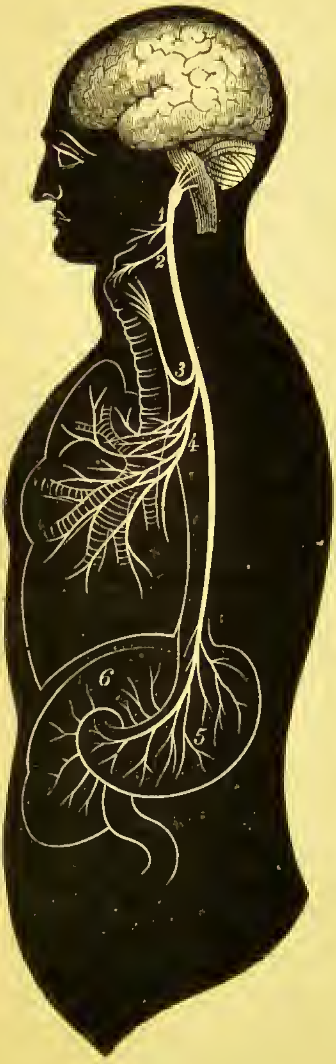


Fig. 28.

The Pneumogastric Nerve.

(1) The pharyngeal; (2) The superior laryngeal; (3) The inferior laryngeal branch; (4) The pulmonary branches; (5, 6) Branches of the stomach.

lung, here spreading out into a network of nervous filaments, from which it issues in the form of two cords. These then pass down by the side of the gullet, joining at numerous points the pneumogastric nerve of the opposite side, forming a plexus or network of nerves, from which the original nerve escapes by one trunk, and then descends on the posterior aspect of the gullet, to be finally spread over the corresponding surface of the stomach. The nerve of the left side of the body, after giving off the left inferior laryngeal branch in front of the arch of the aorta, also descends to the stomach, on the anterior surface of which it is distributed.

The other branches of this nerve, shown in the figure (Fig. 28) are—(*a.*) the *pharyngeal nerve* (1), and (*b.*) the *superior laryngeal nerve* (2),—the former for the pharynx, and the latter to the crico-thyroid muscle of the larynx, the inferior constrictor muscle of the pharynx, the mucous membrane of the base of the tongue, the epiglottis, the larynx, and vocal cords. The inferior laryngeal nerve, before mentioned (3), sends branches to the trachea and gullet, and is distributed to the lining membrane, and all the special muscles of the larynx, except the *crico-thyroid*, which, as we have just seen, derives its nervous supply from the superior laryngeal nerve. (*c.*) The *pulmonary branches* (4), of which there are two sets to each lung—one on the anterior, and the other on the posterior, aspect—are distributed to the bronchial tubes, &c., following these to their minutest ramifications.

The pneumogastric nerve, at first *sensory* in function, soon becomes *compound*, from receiving filaments from motor nerves in its course; and it has accordingly, in nearly all its branches, a double distribution, —that is, one to the muscles for motion, and one to the mucous membrane for sensation. The inferior laryngeal branch is entirely motor, while the superior is mostly sensory. So that any serious interference with the functions of these nerves, either from disease or accident, results in the loss of sensibility to the mucous membrane of the larynx in connection with the *superior* branch, together with loss of motion for the crico-thyroid muscle; and paralysis of all the laryngeal muscles, except that just named, in connection with the *inferior* branch. Since the production of the voice is dependent, as we have frequently seen, upon a certain tension of the vocal cords, which tension is the result of the action of the special or intrinsic muscles of the larynx, it follows that complete loss of voice must ensue if the function of the inferior or motor branch of the nerve be destroyed. It is in such cases as the latter—that is, where loss of voice, partial or complete, has taken place—that its true nature may, to a greater or less extent, be satisfactorily determined by examination with the laryngoscope (see p. 30). For if, in such case, we find no tumour or other probable cause to account for the condition, and the vocal cords are found to be paralysed, we should highly suspect interference at some point with the proper function of the inferior laryngeal nerve; and further investigation, now that the road to be followed had been indicated, would lead to a more certain diagnostic result than by our being left in the dark by the lack of such means of inspection.

The Tri-facial Nerve is another highly important nerve. This, also, is both sensory and motor in function—the division carrying the motor power, supplying mainly the muscles of mastication; and the sensory branch, which is the most acutely sensitive of any nerve in the body, endowing the face, forehead, eye, nose, ear, mouth, and the anterior part of the tongue with *ordinary* sensibility. It also gives to this part of the tongue the *special* sense of taste. The fibres of the sensory portion, just before leaving the skull, are arranged into three distinct bundles, termed respectively the *ophthalmic*, *superior maxillary*, and the *inferior maxillary* divisions of the nerve. The marginal figure (Fig. 29) represents the nerve, and its division into these branches, with the exit of each branch upon the face. The *superior maxillary* (1), besides supplying the parts indicated by the figure, sends twigs to the tonsil, palate, uvula, the

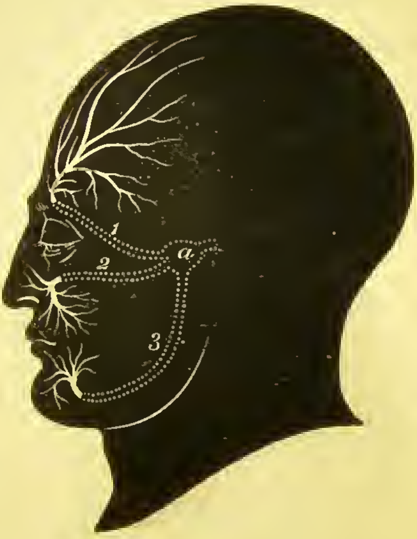


FIG. 29.

THE TRI-FACIAL NERVE.

(1) The ophthalmic branch; (2) The superior maxillary branch; (3) The inferior maxillary branch.

teeth, lining membrane of the nose, and to the upper part of the pharynx. The *inferior maxillary nerve* (2) is possessed of both sensory and motor powers. It supplies the tongue, the teeth of the lower jaw, the mylo-hyoid muscle, the anterior belly of the digastric muscle, and the tensor muscles of the palate. The branch to the tongue,—termed the *gustatory nerve*,—supplies the anterior two-thirds of the organ with the special sense of taste.

The Facial Nerve is the nerve which confers motor power upon the face (Fig. 30). Its point of escape upon the face is seen in the figure. It supplies also the ear, the digastric and stylo-hyoid muscles, &c. The tongue and pharynx have a special nerve devoted to their service, termed accordingly the GLOSSO-PHARYNGEAL NERVE,—that portion of the tongue left unsupplied with the sense of taste by the gustatory nerve being furnished with the glossal branch. The *pharyngeal portion* is distributed to the constrictor muscles of the pharynx. The reflex function played

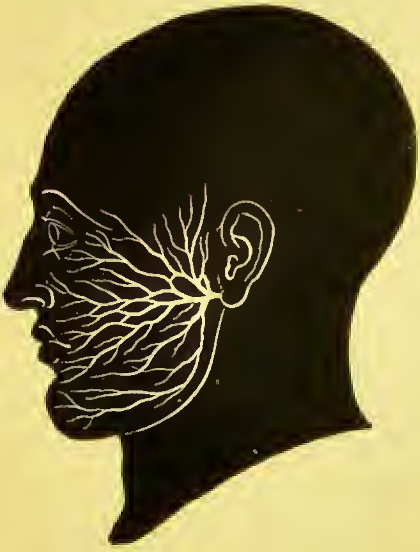


FIG. 30.

THE FACIAL NERVE, showing point of exit upon the face.

by this latter nerve is very important. When food or other natural stimulant comes in contact with the sensitive surface of the pharynx, an impression is immediately sent by the filaments of the nerve placed here, to the nervous centre within the cranium, and then *reflected* to the motor nerves of the constrictor muscles, which at once grasp the food, &c., and push or squeeze it down the gullet. On the contrary, when an unnatural or injurious body excites the nerve into action—as by placing the finger far back in the mouth—the nervous influence is reflected down to the nerves supplying the *stomach*, &c., and vomiting results,—an operation which is at once seen to be of the highest practical value to the well-being, and even to the life of, the individual.

PART II.

THE PRINCIPAL DISEASES OF THE VOCAL ORGANS AND THE CONNECTED PARTS.

In discussing the diseases of the vocal apparatus, &c., it will not be necessary to speak of every complaint affecting the structures, but of those only which are of the most frequent occurrence, or which are the most commonly met with in every-day life, and are the most familiar, therefore, to the general public. And for the reason that many of these affections are quite out-of-the-way ailments, and would not, therefore, prove of any, or but the most minor, interest, except only to the medical world (which has not to be here considered), besides occupying space which could be more advantageously taken up with matter of greater practical value to the majority of general readers.

CHAPTER I.

INFLAMMATION OF THE LARYNX ("LARYNGITIS").

(*a.*) ACUTE, AND (*b.*) CHRONIC, LARYNGITIS.

(*a.*) **Acute Laryngitis,** or acute inflammation of the larynx, is a disease which, if not speedily checked, and before the morbid action has become severe, is attended with serious danger to the patient,—sometimes, indeed, terminating in his death. It consists in inflammation, and consequent swelling, of the lining membrane of the larynx, and of the subjacent structures. The parts become unduly red, swollen, and engorged with blood; and a quantity of liquid matter, differing in character and in abundance, according to the length of time the disease has lasted, or to the intensity of the action, is poured out beneath the membrane. This results in the affected structures presenting a still more puffy and swollen appearance; and one consequence of these changes is, that the calibre of the glottis becomes more or less narrowed and blocked up, resulting in a proportionate degree of interference with respiration, and consequent danger to the patient. This interference with the function of respiration becomes at times so great that air cannot pass the chink of the glottis; and the patient, unless operative measures be speedily adopted for admitting air below the swollen chink, dies suffocated. The inflammation and its results do not, however, always confine themselves merely to the larynx; but the action may extend upwards to the epiglottis, the palate, &c., or downwards to the windpipe, and thus still further increase the danger. The larynx is painful,—the pain being increased on pressure, and made very acute by the act of deglutition; during which, also, particles of food are prone to escape the vigilance of the epiglottis, and then getting into the larynx, to produce painful paroxysms of coughing. The respiration is heard to be husky, difficult, or even laborious; the countenance is seen to be pale and anxious looking; the lips become livid; the nostrils expanded; the pulse is quickened and feeble, and irregular in its beats; there is severe fever; and the voice becomes reduced to a mere whisper. The patient is thus brought down to a most pitiable and dangerous condition; often gasping and struggling for dear breath; and finally becoming, perhaps, delirious; with death in from three to five days.

Amongst the most common causes of this formidable disease are cold and wet; the invasion of the inflammatory action from some neighbouring part; the presence or results of such diseases as scarlet fever, erysipelas, smallpox, measles, or diphtheria; the direct application of scalding or corrosive liquids; and, occasionally, the over-use, or too violent use, of the larynx, as by prolonged shouting, singing, or public speaking, &c.

In the treatment, medical advice should be at once secured, as it is only by the most prompt and vigorous measures, aided by special scientific knowledge, that the affection can be restrained within reasonable bounds, much less dissipated, and the patient rendered safe. The free application of leeches and ice, the administration of depressing remedies and suitable sedatives, coupled at a later stage with counter-irritants, as blisters, &c., and sometimes the operation even of opening the trachea for temporary purposes of respiration, are amongst the means adopted for the arrest and cure of this dangerous affection. The patient should not attempt to speak; his food should be reduced to such light food as milk and slops; no intoxicating liquor should be allowed; and the greatest quietude enjoined upon him.

(*b.*) **Chronic Inflammation of the Larynx.**—In this, and not at all infrequent, disease, the symptoms of the acute form, as detailed above, are reduced in severity, and the danger to the patient is, therefore, correspondingly diminished. Sometimes it springs from the acute form of the disease. It also results from common colds, unusual or excessive exercise of the vocal powers, mechanical injury, certain chronic diseases of a constitutional kind, bronchitis of long standing, &c. &c.

The voice is hoarse or whispering, or lost altogether; the accompanying cough is husky; there is more or less difficulty in breathing, this being often paroxysmal, in which latter case the effort to respire becomes severe, and soon reduces the sufferer to a very weakly and helpless condition, that may, perhaps, terminate in death itself.

It may be treated on the principles indicated in the acute form of the disease, but with much less severity, and with the substitution of a tonic and supporting *régime* for the depressing treatment adopted in the acute disease; also, various solid or liquid remedies may be applied *directly* to the affected parts, aided by the laryngoscope (see p. 30), with the view of restoring the lost tone of the relaxed mucous membrane. Or recourse may be had to the inhalation of certain stimulating and astringent drugs in the form of gases; or the same dissolved in vapour, or applied in the state of an impalpable powder. The forcible application of a stream of vapour, in which sulphurous acid has been dissolved, to the back of the throat, the patient inhaling a little of the solution at the same time, has often been found of the greatest service. But as chronic laryngitis, though not so dangerous to the patient as the acute disease, is yet often sufficiently grave, especially if too long neglected, to cause anxiety as to the result, proper medical advice should always be had in such cases; and the sooner the better, both for the patient's comfort and his chance of recovery. Indeed, some of the remedies mentioned should be used by the medical man only.

In mild cases, the application of a mustard cataplasm for half-an-hour to the front of the neck, over the projecting thyroid cartilage, is a safe, handy, and often a very efficacious remedy. This should be assisted by a smart purge, low diet for a day or two, and as much rest as possible given to the organ by the avoidance of unnecessary conversation ; this, when absolutely indispensable, being carried on in a whisper. Singing, public speaking, &c., are, of course, for the time being, quite out of the question.

CHAPTER II.

LOSS OF VOICE ("APHONIA").

LOSS of the voice may be partial or complete, temporary or permanent, according to the circumstance or condition which gives rise to it; and it may be serious or otherwise, as regards the health or life of the subject. In ordinary cases of mild laryngitis, aphonia, partially at least, is, as we have just seen, of common occurrence, and generally but of brief duration; but in other cases, which will be mentioned presently, the aphonia may be not only complete, but lasting, and simply because the origin of the mischief cannot be got at or removed.

Amongst the causes of loss of voice may be enumerated the following, in addition to those already alluded to:—Weakness of the laryngeal muscles, either from paralysis of the nerves supplying them, or from some debilitating cause operating upon them through the general system; cholera, hysteria, diphtheria, &c. In hysteria the loss is not real, but apparent; and in loss from severe fright the condition is seldom of a permanent character. All this class of causes arise, not from any real disease in the organ of the voice, but from influences acting upon it at a distance and in an indirect manner. On the contrary, the following affect the larynx *directly*, being actual diseases or morbid conditions of the organ itself—namely, *œdema* (or "dropsy") of the glottis, ulcers, the deposition in the larynx of certain morbid matters from the blood (and which afterwards become solidified), owing to certain depraved states of the constitution, in consequence of which the matters in question also become infiltrated into other tissues of the body, as happens in cancerous and tubercular states of the system, for example; also, various tumours, either growing within and upon the larynx itself, or pressing upon it from some neighbouring part, in such a manner as to interfere with the proper vibration of the vocal cords; the growth of warts upon the cords, &c. &c.

It is in cases of aphonia that the laryngoscope proves of such invaluable help. An examination of the glottis, &c., with this useful instrument will, in the vast majority of cases, at once clear up the difficulty which sometimes attends the investigation of these questions. In loss arising from hysteria, for example, the vocal cords are observed to be quite natural in appearance,—of the usual thickness and straightness, lying nearly parallel to, and at a less or greater distance from, each other,—not in motion during the act of respiration,—and quite free from the attacks of any morbid growths. On the other hand, laryngoscopic examination might reveal the existence of a tumour, wart, or other growth upon some part of the larynx, with the exact spot occupied by such growth. As in the case represented in the accompanying figure (Fig. 31), which shows a tumour to have grown from the right vocal cord, and which tumour, on removal, was found to be the sole cause of the loss of voice in the patient who was the subject of the growth.

The treatment to adopt in cases of aphonia will depend upon the cause. In all cases where this cause can be found out, it should first be removed, and the mischief brought about by its action and presence afterwards got rid of. In aphonia resulting from an indirect cause—as hysteria, &c.—this latter disease is vigorously attacked by its appropriate remedies, when the voice will return, if this indirect cause be removed, without any attention being directed to the larynx. Indeed, the less attention paid to the vocal apparatus in certain cases, particularly in hysteria, the better for the sufferer's speedy recovery. Paralysis of the laryngeal muscles is best treated by the local application of electricity, in the shape of a galvanic battery, though the latter should be one of only moderate power. And this may be assisted by constitutional treatment of a tonic and bracing nature, and by remedies peculiarly adapted for the special constitutional cause of the paralysis. In ulceration of the glottis and the immediate parts, we are able, when aided by the

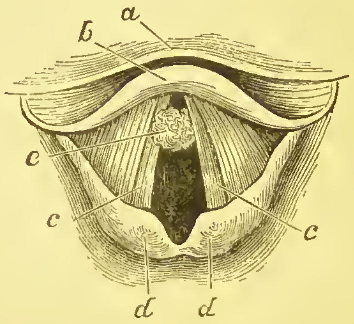


Fig. 31.

Growth of a Wart upon the Right Vocal Cord, causing temporary loss of voice.

(*a*) The base of the tongue; (*b*) The epiglottis; (*c*, *c*) The true vocal cords; (*d*, *d*) The arytenoid cartilages; (*e*) The Wart.

laryngoscope, to apply certain astringent and stimulating remedies *directly* to the affected spot. Or certain agents may be applied in the gaseous or vapourous form by inhalation. And certain tumours, warts, &c., may, as we have just seen, be bodily removed altogether. In dropsy of the glottis, it is necessary at times to prick the swollen parts with a sharp instrument, to give exit to the watery matter infiltrated into the structures surrounding this narrow chink, and to cause them to bleed freely. All these operations, however, fall, of course, to the special care of the medical man, and should on no account be attempted by the uninitiated.

CHAPTER III.

INFLAMMATION OF THE TRACHEA ("TRACHEITIS"), OR CROUP.

THIS is a disease almost peculiar to childhood. It is seldom seen after fourteen years of age. The lining mucous membrane is inflamed and swollen; and soon a membranous structure, not seen in health, begins to form within the tube covering the ordinary membrane. The consequence of this is, that the trachea becomes very much reduced in calibre; indeed, in extreme cases the false membrane may block up the tube altogether, and death result from inability on the part of the patient to draw air within the chest, suffocation immediately ensuing. The affection may also implicate the larynx above, and the bronchial tubes below, in which latter case the disease is especially dangerous. From the first there is difficulty in breathing, which soon increases in severity, and becomes very laboured. The voice is husky, there is a short and peculiar cough, and rattling in the throat; and as the cough becomes increased in severity, a quantity of viscid substance is dislodged, together with portions of the false membrane, and coughed up, the membrane sometimes assuming the shape and size of the tube from which it came, just as if it had been *cast* in it. It is the presence of this false lining to the tube that constitutes the great danger of the disease. If the membrane can be got rid of, and its future formation arrested, or stopped at the outset of the disease, the patient has a chance of recovery; but if its presence seriously interferes with the function of respiration—and it especially does so when implicating the bronchi—the lips soon become blue, the pulse weak, the patient insensible, and death may follow, after a brief but painful struggle, from pure suffocation. There is great fever throughout.

Treatment.—Croup is a highly and speedily fatal disease; two or three days generally sufficing to cause death. No delay should take place in obtaining proper medical advice. It would be useless, and almost criminal, to lay before the reader any plan of treatment in such a dangerous and highly fatal disease, as it might cause tampering and delay where all depends upon early and vigorous action on the part of a responsible, experienced, and trustworthy person. The application of a mustard sinapism to the front of the neck, for five or ten minutes, according to age, would, however, be a safe proceeding, till the medical man could be got to the house; also, the administration of a hot bath for ten or fifteen minutes. For food, nothing but cold milk. If the bowels require moving, give a good dose of castor-oil.

CHAPTER IV.

GOITRE, OR DERBYSHIRE NECK ("BRONCHOCELE").

GOITRE, though not a disease of the larynx or the trachea, must have a place in our notice, because of the injurious pressure which it frequently exercises upon these parts, causing thereby more or less interference with the functions of the structures above which the tumour is situated.

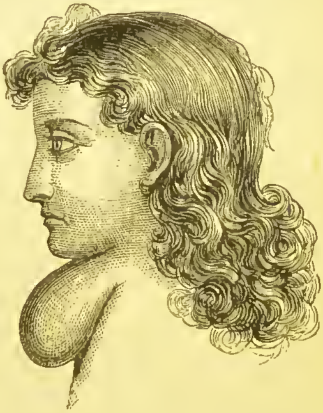


FIG. 32.

GOITRE, OR DERBYSHIRE NECK.

The disease consists in an enlargement of the thyroid gland, as a result of long-continued, and apparently specific, inflammation of the gland. The situation of the gland, and its relations to the surrounding parts, will be better understood by reference to Fig. 15, *i*, page 67; and this will show better than words, perhaps, how any decided increase in the size of the gland will be prone to compress, squeeze, and correspondingly interfere with the functions of the parts near which it is placed; and especially will it press upon the gullet, windpipe, &c., over which the gland is so directly situated. In fact, so great is the interference at times with the duties of the structures named, that operative measures have been rendered necessary to save the sufferer's life,—as when, for example, the tumour has interfered with the act of respiration, by grasping and pressing upon the main windpipe.

From the comparative frequency of the disease in some parts of Derbyshire, it derives one of its names. The presence of the disease, when at all marked, soon becomes visible to every one, as a rounded, bell-like mass, directly in front of the neck, as shown in Fig. 32. It sometimes, however, hangs over the breastbone, or passes up towards the angles of the jaws; and, by its pressure on the trachea, &c., it is visibly seen to interfere with the person's breathing, and to impede the circulation of the blood through the vessels of the neck. When the tumour is long and pendulous, it is generally more in the way,—more of an inconvenience, that is, than dangerous, or functionally obstructive.

The cause of goitre is not exactly made out, but it is most commonly met with in the inhabitants of deep valleys shut in by lofty mountains, particularly if the drinking water be more than usually chalky. It is often associated with a kind of idiocy; and females are more frequently the subjects of the disease than males.

By appropriate treatment, and particularly if commenced at an early period, the tumour may often be speedily dissipated. Long-standing cases are generally the most difficult to manage, and hence the importance of seeking advice, and of adopting the treatment that may then be inculcated, as early as possible after the growth has begun to manifest its presence. If the subject happen to reside in a district where goitre is endemic, he should, if possible, remove into another part of the country, and *there* continue the medical treatment then, or previously, laid down for him. The adoption of such a step takes him away from the original predisposing cause of the deformity, and thus places him in circumstances best adapted for obtaining the speediest benefit from the *direct* treatment by his medical adviser.

CHAPTER V.

BRONCHITIS. (*a.*) ACUTE, AND (*b.*) CHRONIC.

(*a.*) **Acute Bronchitis** (*Acute Inflammation of the Bronchial Tubes*).—This is a very common disease, affecting persons of all ages, in every social condition, and of both sexes. Its most common cause is *a cold*, and it is, therefore, most frequent in winter and in cold, damp weather. In the old and very young it is a dangerous disease,—the number of deaths registered annually in England from this affection alone averaging more than 40,000, and chiefly in children under five years and in the aged. As a general rule, the disease is more dangerous in proportion to the fineness of the tubes inflamed, and the number of them implicated.

It is the lining mucous membrane that is primarily affected, and either directly, or from the spreading of the inflammation from the main windpipe, &c. The membrane is injected or loaded with more than its normal quantity of blood, and it thus becomes tumid and swollen. Its lubricating secretion, which, it will be remembered, is, in the healthy state, just sufficiently abundant to keep it in a supple and moist condition, first ceases to be produced, then becomes increased in quantity, and finally changed into a yellow, stiffish fluid, partly like *pus*. Attending this local change and condition, are more or less lassitude of the system at large,—fever, difficulty in breathing, a sense of tightness within the chest, and incessant attacks of coughing,—which latter, particularly in the debilitated and the naturally weak, are very exhausting and distressing. Moreover, as the secretion just mentioned becomes more and more abundant, and owing to the tenacious matter occupying, and more or less filling, the bronchial tubes, and correspondingly interfering with the admission of air into the chest, there is more and more difficulty in breathing, and, therefore, more and more distress to the patient. All these symptoms become aggravated if the inflammatory action, instead of confining itself to the bronchial tubes proper, passes still further downwards into the air-cells, or, as sometimes happens, spreads to the substance of the lungs. In this latter case, indeed, the attack would be attended with great danger, and especially to young children and elderly people. Sometimes a curious accident happens in this disease. The purulent matter from several of the smaller tubes becoming dislodged, is coughed part of the way up, and before it can be got quite clear of the main windpipe, is sucked part of the way back again, by the act of inspiration, in one large ball or mass; and as this cannot divide and split up into small portions, it plugs up one of the large tubes commanding several small ones, and so renders these practically impervious to air from without. That part of the lung, therefore, ordinarily aërated by these now impervious tubes, becomes, so long as the plug remains in its present position, entirely deprived of air; and then very serious, and sometimes fatal, consequences result,—the patient, perhaps, suddenly dying of suffocation, especially if the tube implicated be of large size. Even when this special accident does not happen, it is generally represented on a small scale by the tumefaction of the smaller bronchial tubes, which may be rendered quite impervious to the inspired air, by the occlusion of their passages, from the swelling of their internal surface. And where complete occlusion does not happen, there is always more or less interference with the entrance of air, and, as a consequence, shortness of breath, more or less marked, according to the number and importance of the tubes implicated.

When the disease is of a milder character, and has lasted a long time, it is termed

(*b.*) **Chronic Bronchitis.**—The chronic form of bronchitis is exceedingly common, and especially in elderly people and the aged. Some people, indeed, seem scarcely to be ever entirely free from it, except, perhaps, for a brief period during the summer months. In winter it is almost the constant companion of the old and infirm; and when one attack has subsided or passed away altogether, and the patient has been restored to comparative ease and comfort, the bronchial tubes are left in such an irritable and weakly condition that the slightest cold or change in the weather, once more sets up the morbid action, which again renders the patient still more susceptible to future attacks. Chronic bronchitis is most commonly the result of the acute form.

It will readily be imagined that, in those whose strength is already sufficiently taxed with the many infirmities incidental to old age, the accession of a disease so debilitating as bronchitis will necessarily be attended with some degree of danger. Indeed, the almost incessant cough, the heavy, impeded breathing, the abundant expectoration of muco-purulent matter, the inability to take even moderate exercise, except on warm, sunny days, the consequent loss of appetite, the distressing flatulence, palpitation of the heart, dropsy, &c. &c., soon tell a sorrowful tale upon the subject of long-continued bronchitis. Besides, other diseases, especially of the lungs and air-tubes, sooner or later follow a continued or repeated attack of bronchitis. The air-cells, for example, may become dilated, producing the disease termed *emphysema of the lungs*,—a not uncommon result of long-standing bronchitis; or the air-tubes themselves may become increased in size, either through a limited length of their whole calibre, or in sac-like swellings at various distances,—conditions both, which will correspondingly reduce the tubes in thickness, elasticity, and, therefore, usefulness; or particular parts, again, of the lung may become completely collapsed, and hence be of no further use for respiratory purposes. Sometimes the *severe paroxysms* of coughing to which the subjects of this disease are so pre-eminently prone are of sufficient severity to cause rupture of one or more blood-vessels, either within the chest itself or, what is still more grave, within the head, and especially as the blood-vessels of the aged are more than ordinarily weak and fragile. Such an event is, of course, if not speedily fatal, yet exceedingly dangerous and debilitating, and places the sufferer in a still further condition of peril.

We see, then, that one morbid condition, especially if chronic, sooner or later leads to another, and that this other leads on to others still; and, finally, that these adverse conditions, acting in concert with one another, and the original disease being still in operation, a load of weaknesses and troubles is ultimately brought upon the unfortunate sufferer that is quite incompatible with the further prolongation of his life.

The treatment of bronchitis varies according to circumstances, such as age, the severity or mildness of the attack, the strength or peculiarity of the patient's constitution, the time the disease has lasted, &c. In mild cases of the *acute* form of the disorder in the adult, and in persons of the usual constitutional powers, a good smart purge, containing calomel and jalap, and the administration even of an emetic, may be commended; also, the application to the chest for twenty or thirty minutes of a mustard or turpentine sinapism, followed by hot and thick linseed-meal poultices, these being kept warm by bags of heated salt, bran, &c., or changed before becoming cooled. Rest in bed, in a warm room, and milk and beef-tea for food. In those of a sanguineous temperament, possessing unusual fulness of blood and great robust-ness, the abstraction of blood from the arm, followed by nauseating doses of tartar emetic (the one-sixth to one-fourth of a grain, or more), frequently repeated, may be advisable. The cough, which is generally very distressing, should be restrained, but not stopped, by appropriate sedative medicines, and free perspiration induced by hot drinks, &c.

In the aged, the very young, and the debilitated, the foregoing plan of treatment would tell too severely upon the general constitutional powers. In these, the abstraction of blood is especially undesirable; as is also the production of much nausea. On the contrary, it is often found necessary to administer stimulating drinks, even from the outset. Hot applications may, however, in all cases be recommended; free purgation, sedatives for the oppressive cough, confinement to a warm room, and light but nourishing food, &c.

As the disease subsides, and the secretion begins to form, stimulating expectorant remedies are indicated; also, good, nourishing food; and in cases of much debility it may be necessary to allow a little brandy or whisky. In children, who have generally great difficulty in getting up the abundant secretion, the induction of vomiting will give great relief; and often, this may be daily repeated with the most marked advantage.

In *chronic* bronchitis, milder measures are adopted throughout. Here we obtain the most benefit from soothing and expectorant remedies of a stimulating character, nourishing food, wine, &c. All unnecessary exposure to cold should be avoided, as well as sudden changes of temperature, whether from warmth to cold or *vice versa.* When the mouth cannot be kept closed, it is advisable to have it covered with a respirator; and in very cold weather, outside the house, the nostrils may be covered by a pervious woollen wrapper. A piece of flannel or a plaster of pitch, &c., may be advantageously worn next the chest, as an additional protection from sudden changes of temperature. These remarks apply particularly to the aged, and those permanently invalided.

In consequence, probably, of bronchitis being in England so common a malady, it has come to be generally regarded by the masses with far more indifference than its importance demands. A cough, though slight, but yet persistent, is not, however, to be neglected with impunity, and looked upon and treated as a complaint of but minor consideration. It is always desirable to obtain at once proper medical advice, even in slight cases, that the mischief may be eradicated before it becomes developed into the chronic form of the disease, which, as we have seen, is often a very troublesome and debilitating affection, and one which often leads to other evils of great magnitude. Quacks — pretended American "doctors," whose "diplomas" are obtained from "universities" which have no existence; herbalists, whose duty is *to sell herbs*, and *not* to prescribe for disease, and their so-called specific medicines — should be decidedly shunned; as also the thousand and one nostrums so prominently advertised in the newspapers, and scattered broadcast over the land by means of handbills, &c. The mere enumeration of the baneful effects produced by these ignorant pretenders, and their destructive nostrums, not only upon the course of the disease which they presume to understand and to be able to cure, but also upon the general animal economy, would be no ordinary task to undertake. The people who would never think of asking a shoemaker to make them a piano, or a blacksmith a dress suit, or a straw bonnet-maker to shoe their horses, should be sufficiently thoughtful and consistent not to endanger their healths and lives (which are supposed to be of far greater value than pianos, dress suits, &c.) by seeking or accepting medical advice and aid from persons who know, perhaps, even less of disease than the foregoing useful members of society know of one another's handicrafts. These remarks apply with equal force, of course, to many other diseases and ailments; but as every old woman thinks herself qualified to prescribe for, and to treat "a cough," it is perhaps more particularly necessary to call attention to the subject in connection with bronchitis, a disease of such common occurrence in the British Isles, and one in which the careful supervision of a properly-trained and conscientious medical man is so pre-eminently needed.

The importance of these remarks to the future wellbeing of the patient cannot well be over-estimated.

CHAPTER VI.

EMPHYSEMA OF THE LUNGS.

We have already incidentally mentioned this disease (see p. 179) as consisting in an enlargement of the air-cells of the lungs, and as being chiefly caused by persistent, or frequently-recurring, attacks of bronchitis. The almost incessant coughing, which, as we saw, is so constantly the companion of this latter disease, in time greatly impairs the elasticity of the lungs,—that is, their power of contracting after being distended,—owing to the frequent concussions to which the air-cells are then subjected from the contained or imprisoned air; the cells being from this cause dilated, and rendered incapable of again resuming their normal size. There is hence a corresponding increase in *the whole volume* of the lungs; and one consequence of this is, that the heart becomes unduly pressed upon by the enlarged lungs, its action proportionately hampered, and its freedom of movement curtailed, this resulting in distressing attacks of palpitation of the organ, and other incidental troubles and discomforts. But this is not all. The minute blood-vessels, which, as we have elsewhere seen, completely surround each of these air-cells (see p. 80), likewise suffer from the pressure; they become squeezed and compressed between the enlarged, adjoining cells; and thus the passage of the blood through these vessels is accomplished with much more difficulty than when not subjected to this squeezing, and consequent partial occlusion of their internal calibre. This pressure upon the capillary vessels surrounding the air-cells, likewise tells upon the heart, and causes disturbance in the performance of the duties and obligations of this organ. Thus, for example, the heart, in order to overcome the obstruction caused by pressure upon the capillary vessels, has to labour with proportionately increased effort; and this increased duty, and increased difficulty of accomplishing its perpetual task, tends still more to produce attacks of palpitation, and to cause faintness and other ills, so frequently complained of in this disease.

There are also, permanent shortness of breath, imperfect aëration of the blood, headaches, attacks of dizziness, blueness of the lips, &c. Sometimes, certain of the air-cells become so thin in their walls from excessive dilatation, that they give way altogether; and several cells may thus become in direct communication with one another, by the rupture of their adjoining walls,—a circumstance which still further reduces the superficies of the aërating surface. In time, the whole venous system, but more particularly that of the lungs, becomes over-burdened or engorged with blood, which is at the same time more or less impure; the hands and feet become afflicted with almost constant coldness; they also become more or less puffy and swollen; and the stomach, partaking of the general derangement, dyspepsia is the frequent result; loss of appetite; and more or less emaciation of the system at large. This leads on, sooner or later, to general and extreme debility; which is made still worse by the frequently-recurring fits or paroxysms of coughing, and exacerbations of the already too oppressive breathing. And ultimately, the condition of the sufferer becomes very pitiable indeed, his life being often a burden to him. Sometimes he dare scarcely lie down to rest, owing to the extreme difficulty he experiences, when in the horizontal position, in getting his breath. At last, the heart becoming irremediably diseased, the palpitations of the organ become more and more violent and distressing; the circulation of the blood is carried on with great effort and much imperfection; the lungs become sodden with blood, almost to stagnation; and the general feebleness rapidly increasing, death soon follows, to free the distressed patient from his many pains and hard-fought struggles.

The treatment to be adopted for this distressing malady is nearly that recommended for the chronic bronchitis of the aged, and to which the reader is therefore referred (*vide* p. 181). There is nothing to be done, of course, for the worn-out lungs; the physical structure of which, and the numerous degenerative changes which they have undergone, being irremediable. The sudden exacerbations of bad breathing may be relieved by the administration of a good stimulant, combined with certain of the ordinary sedative remedies;—by keeping the shoulders well elevated, and providing the patient with free supplies of fresh, and, if possible, cool air,—as by throwing the windows wide open, fanning the face, &c. Sometimes, when there is much flatulence, or when, after an unusually hearty meal, a paroxysm of bad breathing is anticipated, it may be cut short, or altogether prevented, by giving an emetic,—such as a teaspoonful of mustard in plenty of lukewarm water, &c. The bowels should be kept open by black draught, or similar appropriate laxatives. The food should be light and nourishing. Whatever is found to produce or encourage flatulence, indigestion, &c., should be rigorously avoided. Wine may be given, or, if necessary, a stronger stimulant,—as a little brandy, &c. The body should be kept warm by suitable clothing; the functions of the skin maintained in activity by tepid sponging, at least once daily, immediately succeeded by brisk frictions; and the feet protected from cold and damp. Very little active exercise can be taken by the subjects of this affection, owing to the shortness of breath, which is always present, and which becomes still more embarrassed and oppressive on exertion. The functions of the skin may, however, be encouraged by the means just recommended; and with great benefit to the comfort and general condition of the patient.

The great practical lesson taught by a consideration of this disease, is to do everything in our power to guard against the causes that produce it, or that predispose to it. Amongst the most common of these is, as we have seen, chronic bronchitis; and this, as we also know, most frequently results from repeated attacks of the acute form of the disease; which latter, again, in the vast majority of cases, arises from the combined action of cold and wet, and careless exposure to sudden changes of the weather. In short, the lesson to be learnt is,—to be careful to guard against the evils just enumerated; and when, from any cause, we should happen to have a bad cold, implicating the breathing tubes and producing a cough, we should have recourse at once to the best and speediest means obtainable for its removal; all quacks, and their so-called "remedies," being carefully avoided.

CHAPTER VII.

SPASMODIC ASTHMA.

ASTHMA differs from emphysema in the attacks of bad or difficult breathing, which characterises both diseases, being in asthma purely *paroxysmal*—that is, in the attacks lasting for a time only, with intervals of perfect freedom from the oppressive breathing. *A fit of the asthma*, as it is termed, is most distressing even to witness, much more to personally experience. It commences, most usually, at night; and in extreme cases consists in a sudden and extremely oppressive attack of bad breathing, or, more properly, almost total arrest of breathing, in consequence of spasm, and the more or less complete closure of, the air-tubes. The sufferer feels, for the time being, as if every moment was to be his last. He sits in a semi-recumbent posture, with widely-opened mouth and distended nostrils, his shoulders elevated, his head thrown back, and all the muscles of inspiration acting in a most vigorous and energetic manner—indications these, of the severity of the struggle for air in which the poor invalid is engaged. And, in consequence of the imperfect supply of air to the lungs, the blood becomes only partially purified, and passes from these organs into the vessels of the general system, proportionately dark coloured, causing that blueness of the lips, of the finger-nails, &c., which so very soon manifests itself to the eyes even of the most careless observer. After a time, varying in length according to the violence of the attack, the spasm begins to abate, the air-tubes gradually become open, more and more air gains admission into the lungs, the blood becomes more aërated, the lips, &c., regain their lost colour, and, in a varying period, the patient respires as naturally as before the paroxysm ; but is left in a more or less prostrated condition, as we should imagine, from the trying ordeal through which he has just passed.

The severity of a "fit" varies, of course, in different individuals, and even in the same person ; some attacks being comparatively mild, and others unusually violent. The result upon the general condition of the patient likewise varies—according to his constitutional powers, his age, the frequency of the attacks, the absence or presence of conditions peculiar to some persons or to certain localities, and the length of time the patient has been afflicted with the disease, &c.

Asthma seldom attacks the young, owing to the conditions which give rise to it not having had sufficient time to develop themselves, or from not having been long enough in operation to affect the system in this particular manner. These conditions or causes are usually one or other of the following, or a combination of them—namely, peculiarity of constitution, derived from one of the more immediate ancestors of the sufferer, but especially the inheritance of the asthmatic disposition ; a condition of body devoid of proper tone; frequent or persistent attacks of indigestion; the gouty diathesis, &c. In some persons, the inhalation of certain drugs, or the smell of fresh hay, is sufficient to promote an attack—in which latter case the paroxysm is termed *hay asthma;* also disorders or abnormal conditions of the bowels—as the presence of worms in them, or where, in consequence of their torpidity, they have become overloaded, or unusually flatulent, &c.; certain diseases of the heart or of some portion of the nervous system; an excessive or imprudent meal, or the abuse of alcoholic drinks; and unnecessary or unavoidable exposure to certain kinds of weather, especially in those who inherit a predisposition to the disease,—a remark which, by the way, applies equally to the rest of the exciting causes. Emphysema (see p. 184) is also sometimes present in asthmatic subjects, in which case the condition of the patient is still more pitiable, for then he is *never* able to respire with perfect freedom. And further, when the asthmatic paroxysm comes on, he is placed at a still greater disadvantage for performing the respiratory function, and his sufferings become, in consequence, all the more intensified, and his general physical powers all the more undermined and exhausted.

In the treatment of asthma our efforts must first be directed to the relieving or subduing of the *paroxysm;* and afterwards to the adoption of such measures as are best calculated to prevent the recurrence of the attack, as well as to remove, as far as we are able, the exhaustion and other ill effects, brought about by the struggle through which the patient has passed.

(*a.*) *During the paroxysm* we may open wide the windows, or fan the patient's face; loose the clothing about his neck and chest; and support him in a sitting posture with pillows, &c. If he have eaten immoderately, or partaken of food which he cannot easily digest, it is best to administer an emetic,—say of mustard and water—one teaspoonful to a cup of lukewarm water,—followed up by frequent draughts, more or less copious, of the latter, till vomiting ensues. In those whose physical powers are not much reduced, it would be better, when the indication exists, to give, in place of the mustard, a tartar-emetic powder, dissolved in warm water, containing from half-a-grain to two grains of the drug, according to the powers, &c., of the patient with whom we have to deal; and, to assist the action of the powder—if this be not sufficiently speedy—by tickling the back of the throat with a feather, or by placing the finger far back in the mouth, &c. Such a plan will sometimes at once cut short the paroxysm. When the stomach is not overloaded, and there is no reason to suppose that this viscus is exercising any prejudicial influence upon the attack, and the bowels have been ascertained to be in proper order, we may attempt to subdue the "fit" by the administration of what are termed *anti-spasmodic* remedies—such as, for example, chloroform, æther, assafœtida, valerian, &c. Or, by the patient's being asked to smoke, if he can command sufficient breath for the purpose, a few of the *leaves of stramonium*, either through a clean pipe, or, as they may now be obtained, in the form of cigarettes. The early examples of remedies—namely, chloroform, &c.—should not, however, be used by the patient himself, or of his own accord ; nor should they be given or employed by his friends, except only under the direct supervision of a legally qualified medical man ; as very disastrous results might happen in the hands of those not thoroughly and practically acquainted with the properties and uses of these drugs. The stramonium will be the more likely to answer if used *immediately the attack is known to be beginning*, and without waiting for its full development. Indeed, in order that no time be lost in giving this drug a fair chance of exercising its powers and full benefit upon the patient, every means conducive to its being promptly used, when the occasion demands, should be in readiness. The pipe, for example, should be kept charged with the crumpled leaves, and laid by in a special place, near at hand, where it can at once be found when wanted. The lucifer matches, too, should be close by, in order that not a moment's time may be lost in searching for and applying a light when the paroxysm is felt to be coming on. When these precautions are fully adopted, the attack may be often immediately suppressed ; but when undue delay has resulted in igniting the pipe, the remedy as often fails, and not always because the paroxysm has become too fully developed, and therefore too powerful, for the smoke of the stramonium leaves to subdue, but because the remedy cannot be properly used, owing to the inability of the patient to spare sufficient breath for the due *inhalation* of the fumes. Sometimes, however, it is sufficient that the leaves be smoked by a friend—

the fumes evolved being puffed in the patient's face; but this plan is not nearly so efficacious as the former.

The fumes of burning saltpetre, also, induce in some persons a speedy improvement and mitigation in the severity of the fit, and in others a total suppression of the paroxysm. In using this remedy, strips of coarse and moderately-thick blotting-paper are steeped in a saturated solution of the drug, hung up to dry, and put away in some handy place ready for prompt use when occasion calls. When the attack is known to be approaching, the papers are immediately lighted in the patient's room, which soon becomes filled with a dense, but not unpleasant smoke, and this the sufferer vigorously inhales till relief is obtained.

Of late years numerous smoking mixtures of various kinds of leaves, &c., rolled up into the form oi cigarettes, have been largely advertised, and pretty freely employed by the public for this distressing complaint. Some of these—as those made of the *datura tatula*, a kind or variety of stramonium—are often very efficacious, while others, again, are quite inert. After having failed in the use of these, I have, on two or three occasions, obtained the most satisfactory results from the administration of assafœtida, from five to ten grains every hour; and where flatulence is present, as often is the case in asthmatic subjects, this drug is specially indicated. Common tobacco, in non-smokers, is also at times a speedy and effectual remedy for the asthmatic paroxysm.

(*b.*) *After the subsidence of the paroxysm*, the patient requires good, but light, nourishing food,—as chickenbroth, beef-tea, mutton-broth, &c., taken with crumbs of bread, or pearl-barley, or rice, &c. And where the exhaustion is great, he will require temporary stimulation with wine, or brandy, &c. Great care must also be taken against catching cold, or the attack may soon return. The patient's food should never be heavy, and too much should never on any occasion be taken at one time. The bowels should be carefully watched, and their torpidity corrected. Night-air and late hours should as much as possible be guarded against, as well as unnecessary exposure to cold, damp, or foggy weather. When, however, it becomes imperative to be out-of-doors on cold, damp days, the mouth should be covered with a respirator, or a warm muffler, &c.

If the cause which brings on the paroxysm can be found, this should, of course, be subsequently avoided. A change of residence from town to country, or *vice versâ;* or from the top of a hill to the valley; or from a low-lying locality to a neighbourhood more elevated, has each been known to cure the most obstinate cases of asthma, and after the failure of every other known means or remedies. An asthmatic subject may, for example, be living in a close and unhealthy street, or in a low and damp situation, when, owing to some circumstance which induced or compelled him to remove to a locality which happened to be high and dry, he has found by the simple change the affliction of years suddenly uplifted, and he breathes again with a freedom which none but an asthmatic subject can fully appreciate. However, on again changing his abode to his old neighbourhood, the complaint has returned also, and has continued its inflictions upon him until he once more betook himself to the place he had so unwisely left. On the other hand, again, relief comes in another case only when the subject resides in the very locality which proves so obnoxious to the person whose case has just been narrated—the attacks returning when living in purer air and in a more healthy neighbourhood! There is really no accounting for these curious cases. It is related of a certain nobleman, the subject of asthma, that after the trial and failure of all known remedies, he at last found relief in the air of a certain hill-side near the city of Nice, and he accordingly built himself a mansion there, wherein to live in peace and comfort from the attacks of his old enemy. But, sad to say, the enemy in course of time found him again; the paroxysms returned, and these nothing removed. One day, however, when out riding, and when suddenly attacked with one of the old fits, he passed for nearness' sake to his home through one of the narrowest, dirtiest, and most unhealthy streets of Nice, when suddenly, and to his great joy and astonishment, the paroxysm left him, and, with thankful heart, he once more breathed freely! In a subsequent attack, he again sought out this dingy street, and again found immediate relief in it; so that ultimately he found it indispensable to his existence that he should take up his abode in that offensive quarter, and leave his grand mansion on the lovely hill-side! It is stated that he never had cause to regret the change, for the attacks never returned while he resided in that unsavoury locality.

These cases are really very puzzling, if not altogether inexplicable. At the same time, they are very instructive, and in certain cases may serve as guides for treatment. "For," as one of our leading English physicians has observed, "there is probably an atmosphere suitable for every case of asthma, did we but know where to go to find it."

It appears, then, that asthma is a very capricious malady, both as regards its cause and cure, and also as regards the kind of weather which most favours its development or decay. Some cases are benefited by the prevalence of damp, foggy, and cold weather; while others, again,—and these are in the majority,—are sure to become worse, a paroxysm being sure to happen on the appearance of a foggy day. Lastly, it is advisable that the subjects of this complaint should exercise their vocal organs as little as possible,—that they indulge but lightly in physical exercises,—and that they be "moderate in all things."

CHAPTER VIII.

INFLAMMATION OF THE LUNGS ("PNEUMONIA").

THIS dangerous, and not infrequent, disease consists in inflammation of the *substance* of the lungs. There are three stages or periods in the attack. In the *first*, or that of *sanguineous congestion*, the lungs are loaded and sodden with blood, but still sufficiently light to float in water. In the *second stage*, or that of *red hepatisation*, the disease has advanced so far as to render the organs impervious to the ingress of air; and the lungs, if now cut into and examined, present, instead of the sponge-like, or honey-comb, character, a smooth, even, and liver-like appearance, quite devoid of their usual porous character, and so heavy as to sink in water. In the *third stage*, that of *diffused suppuration*, there is destruction of the part implicated, which is found, moreover, to be loaded with purulent fluid, and to be soft and rotten in consistence.

Pneumonia is usually the result of one or other of the following causes—namely, cold; bronchitis; sudden changes of temperature; certain constitutional diseases, as fevers, consumption, &c.; diseases of particular organs, as the kidneys or the heart; unusual fulness of blood; or the opposite condition of great or prolonged constitutional debility, especially when a result of bad feeding, and coupled with such debilitating influences as insufficient clothing, sleeping in damp beds, carelessness in changing wet clothes, &c.; also, the habit of *tippling*, &c. &c.

The attack may commence suddenly,—as usually happens when it arises from cold, or when the subject is very plethoric,—with a fit of shivering, followed by headache, great thirst, loss of appetite, a flushed face, red eyes, languor, great fever, general disorder of the secreting organs, and great general debility. Or it may commence insidiously, as is usually the case when arising from fevers, or in debilitated conditions of the system, &c. Accompanying the above general symptoms are—a deep-seated, dull, heavy pain within the chest; a short, dry cough; and the expectoration, in the course of one or two days, of peculiar and highly-characteristic sputa,—thick, heavy, tenacious, and rust-coloured,—this latter quality arising from the intimate admixture with it of blood from the ruptured vessels of the engorged lung. The breathing is short and quick,—the number of respirations having increased from about sixteen or eighteen per minute, to thirty, or even more. If the attack happen to be comparatively mild, or the treatment adopted sufficiently vigorous and successful, improvement may commence at about the fourth day. But in severe or unfavourable cases, the inflammatory action will continue and increase in severity and in area,—spreading by continuity to other parts of the lung, and developing still further the symptoms just enumerated; and, should the case be very unfavourable, other still more alarming indications,—such as extreme feebleness of pulse, cold, clammy sweats, rattling in the throat, insensibility, extreme fœtor of breath, indicative of gangrene or mortification of the diseased lung; and then the death of the patient.

The intelligent treatment of this formidable disease cannot begin too early. The old adage which affirms that—

> "A stitch in time saves nine,"

is particularly applicable to the treatment of pneumonia. And it is always by far the safest, and therethe best, plan, to call in proper medical advice immediately upon the foregoing symptoms declaring themselves. Such being the advice here tendered, it will be sufficient further to add only, that to save time, a mustard sinapism may be placed on the chest, in the region of the painful spot; the patient being at the same time put to bed in a warm room, and quietness enjoined upon him. Also, if the bowels be not already freely open, a brisk purgative may be administered. The adoption of these expedients will do no harm, even if a wrong diagnosis has been made; and if this happen to be correct, the greatest services will have been rendered to the patient, before he is given over to the doctor's care.

Afterwards, when recovery has taken place, the patient would do wisely to adopt the advice and follow the instructions laid down under the chapters "Bronchitis," and "Emphysema" against catching cold, and other similar precautions.

CHAPTER IX.

PULMONARY CONSUMPTION ("PHTHISIS PULMONALIS").

THIS destructive, and in the British Isles highly prevalent disease, which, it is calculated, destroys in these islands alone upwards of 50,000 persons annually, begins generally in a very insidious manner; with at first, perhaps, a short, dry cough, slow, but increasing debility, hectic fever, wasting of the body, marked loss in the "vital capacity" (*vide* p. 92, *et seq.*);—succeeded by the expectoration of muco-purulent matter, which may be more or less tinged with blood, attacks of pure hæmoptysis, or spitting of bright scarlet blood, early loss of appetite, much thirst, shortness of breath, a quick and weak pulse, palpitation of the heart, especially on exertion, great and rapid emaciation, and painful prostration, &c.; followed generally in a couple of years from the outset of the more marked symptoms, by the death of the sufferer.

The lungs, at the commencement, are found to be studded with what is termed *tubercular matter*—a peculiar product generated in the system of consumptives, and deposited not only in the substance of the lungs, but also in nearly every organ of the body. This tubercular matter, which is of a cheesy consistence, may lodge in the various organs in an inactive or dormant condition for a long period,—even for years,—before betraying its presence by any marked effects upon the constitutional powers. The subject may, indeed, be profoundly ignorant that such a disease is hanging about him. In time, however, he catches cold, perhaps, and has an attack of bronchitis ; or becomes the subject, voluntarily or involuntarily, of some debilitating excess, which reduces him in health, and brings his constitutional powers below the normal standard,—and they are already generally below par,—when the tubercular matter, previously lying for a length of time in a state of quietude and apparent indifference, suddenly takes upon itself marked activity, irritating the organs in which it is lodged,—more especially the lungs ;—and so initiating those series of morbid processes which, if not arrested, ultimately lead on to confirmed consumption, and the death of the patient.

The continued irritation to which the lungs are subjected by the presence in them of these tubercular deposits (termed *tubercules*), eventually sets up inflammation in the regions immediately surrounding and enclosing them ; and this process continuing, and increasing in intensity, soon cuts off or isolates the tubercles from the living lung ; and having now, therefore, no means of obtaining nourishment from the lung-substance,—this being the structure by which they were kept alive,—they become dead and effete masses in the organ. These dead matters then prove, as we should readily imagine, a still more active source of trouble and annoyance to the lung, and therefore to the patient, intensifying the already distressing cough, and still further reducing the patient's very limited powers. Eventually, the tubercles becoming liquified, or broken down into purulent matter, are by degrees coughed up, and so got quit of. But this is not the only evil: for they also take with them, in this act of breaking down, &c., a portion of the lung-tissue, destroyed at the same time, and leave behind them a number of hollows or *cavities*, as they are called, in the place of these tubercles. So that, if the tubercles happen to be very numerous,—and they sometimes literally *stud* the organs,—it will readily be seen what destruction must result to the lungs by this process of continual breaking down of the tubercular matter, and, in the long run, how riddled with cavities these organs must be. Also, how the superficies of the aërating surface of the lungs must, in consequence, become more and more diminished; and how the strength of the patient becomes finally worn out by increasing troubles. The almost incessant paroxysms of coughing; the loss of blood from the frequent breaking of blood-vessels,—if, indeed, the rupture of one large vessel do not terminate his trials at once; the inability to eat, or to digest the little that *is* eaten; the continued presence of fever; the want of rest, &c. &c., these speedily record a sad tale in the sufferer's life-history.

Amongst the *causes* that may be assigned for this fearfully prevalent and fatal disease may be enumerated the following—namely, heriditariness,—one or more of the patient's ancestors, or collateral members of the family, having also suffered from it; bad or insufficient food and clothing; unhealthy dwellings,—as living in low and damp situations; weakening occupations,—especially if carried on in long-continued absence of daylight, as in those who work, for example, in coal-mines, &c., where the constant inhalation of coal-dust adds still more to the adverse influence; excessive indulgence in the sensual passions, or other debilitating practices,—such, for instance, as long continued tippling, &c.; frequent attacks of bad colds, or of bronchitis, particularly in those who are predisposed to consumption; overwork, physical or mental; prolonged over-anxiety, &c. &c. The disease is most common between the ages of eighteen or twenty and thirty years; but no period of life is exempt from it. It is not contagious. When phthisis has once fairly set in, it thereafter usually destroys the patient in from two to three years.

The treatment of consumption may, for the sake of convenience, be divided into the (1) *preventative* and the (2) *active* treatment. The latter, which comes under the care and management chiefly of the medical attendant, we shall do wisely to leave with him, and to carry out in all their integrity the instructions he carefully and tenderly inculcates. We shall, therefore, confine our remarks to the former head.

Those who, through their ancestors, have inherited a predisposition to the disease, should particularly guard themselves against indulgence in any kind of debilitating habits and excesses; and should also avoid, as much as circumstances will allow, all the predisposing causes of the disease, as just enumerated. Their clothing should, at all times and seasons, be sufficiently good and abundant to preserve the body at an agreeable temperature, but without being so excessive in weight or quantity as readily to induce perspiration. The food should be nourishing, and of such a kind as to admit of being easily digested. The occupation should be as healthy in character, and of as easy and comfortable a kind, as possible;—one not necessitating excessively long hours, or prolonged or over-exertion, or inducing much fatigue, either physical or mental;—one not requiring, on the one hand, a too prolonged absence from the fresh air and the bright sunlight; or, on the other hand, too much exposure to damp or inclement weather. Night-air is to be avoided; early hours for retiring to rest the rule; and over-heated rooms are to be deprecated. In cold weather it is advisable to keep the mouth closed, or to wear a respirator. The bowels should be kept regular, and a cheerful demeanour and pleasant society cultivated. We may also recommend for adoption the instructions and suggestions laid down under the chapter "Bronchitis," &c.—such as the avoidance of sudden changes of temperature, whether from cold to warmth, or *vice versâ*.

Those in whom the predisposition exists may, when the remedy can be borne, or when it does not interfere with the appetite, take cod-liver oil, in doses, according to age, of from a teaspoonful to a tablespoonful, three times a-day immediately after food; and for a period extending at least to four or six months, or even longer, without intermission, if the subject do not begin to get stout under its use by the time specified. The oil is conveniently taken swimming on port-wine, ginger-wine, or, where the appetite is not sufficiently good, and the drug can be tolerated by the stomach, upon quinine-wine.

In the case of young girls of fourteen or fifteen years old, whose monthly functions have not yet begun to manifest themselves, medical advice should be had without delay; and the remedies advised for the establishment of the function rigorously and perseveringly carried out,—and more especially if the family history be not, in a phthisical sense, quite satisfactory;—as such subjects, and under such conditions, are particularly and pre-eminently prone to the consumptive manifestation, and rapidly to become the confirmed victims of the disease. But such an event may at least be considerably postponed, if not altogether kept at bay, by the successful promotion of the function in question.

It may, perhaps, be as well to state here that some medical men have asserted, and do assert, that though consumption may be developed in a person addicted to the more debilitating of the foregoing habits, if practised for a prolonged period, and in whose immediate ancestors no history of phthisis can be traced, yet that it is highly probable,—or at least it is often found to be the case,—that one or other member of the consumptive's family has been, or is, the subject of *cancer*, or other malignant tumour ; the two diseases, consumption and cancer, alternating with each other in the succeeding generations. That is, a consumptive father or mother may transmit consumption to the child ; but it may be *cancer* instead ; and that the child, if the subject of cancer, may transmit, probably cancer, but possibly consumption instead. And I have often found this statement to be unquestionably true. Many times, indeed, I have hazarded the remark to a consumptive that his father died of cancer ; and to a cancerous subject that his father or mother died of consumption ; and with scarcely an exception the conjecture has proved to be correct,—except, of course, when the disease of the parent has been inherited by the child. At the same time, a consumptive subject is more likely to transmit consumption to his own child than cancer or other malignant growth ; and the same remark holds good with regard to cancer in the case of a cancerous parent.

Where, from the preceding considerations, the development of phthisis is thought to be probable, or possible, the subject would do well, in addition to the adoption of the advice already recommended, to fix his abode if possible in a locality containing a dry sandy soil, as much sheltered as possible from the north and east winds, and having a south-westerly aspect. If the circumstances of the patient will allow, he may winter with great advantage in a more congenial clime, selecting, by preference, a dry bracing atmosphere, as Egypt, &c. Advice on this point cannot, however, be made of general application, as different constitutions, and varying stages of the disease, will require different management. It is better that each individual case should be separately considered, and the opinion of the medical attendant consulted on the subject; his recommendations being afterwards as much as possible carried into execution.

Lastly, for an account of the beneficial effects found to accrue to a threatened consumptive by the intelligent exercise of the lungs, as by singing, playing upon wind instruments, &c., see p. 105.

CHAPTER X.

PLEURISY (PLEURITIS).

THE pleura (one to each side) is, as we have already indicated, the bag of serous membrane in which the lungs are contained. The membrane is closely applied to the lungs by what is termed the *pulmonary* part, and to the inside of the chest by the *costal* portion. These opposed surfaces are also *ap*posed to each other; and, in their healthy condition, move smoothly upon each other during every respiratory act. Either of these portions of the pleura, or both combined, may be affected with inflammation; and the disease may attack the pleura of one side of the chest only, or of both sides, and either successively or simultaneously.

Pleurisy, or inflammation of the pleura, and especially the mild form of the disease, is quite of common occurrence in the British Isles. It is not, however, usually dangerous to life, except when an extensive surface is implicated, or when it attacks the naturally weak, or those who are already much debilitated by other maladies.

Its onset is indicated, when at all acute, by the presence in the side, at the affected spot, of a very sharp, cutting, or stabbing pain, usually described as being like a knife pricking the part. This pain is greatly increased by drawing a deep breath; in some cases, indeed, the subject of the attack scarcely dare breathe at all, as he certainly would not if he could help it, so painfully acute is the attendant *stitch*, as it is sometimes termed. The pain appears to be caused by the rubbing, and perhaps the partial sticking together, during respiration, of the now tender and inflamed portion of the pleura upon its apposed part—the usual free and easy action of which upon each other being now destroyed, or more or less in abeyance. One consequence of this partial, or semi, respiration is, that the blood undergoes but partial aëration, and passes on into the general system more or less dark coloured,—as is evidenced by the marked lividity of the lips, &c.;—and such a condition of matters, in children more especially, soon leads to incomplete, or occasionally *total*, insensibility, followed by convulsions, and, if not soon remedied, death. In the latter case, the patient dies, not from the severity of the attack *per se*, or from the intensity of the accompanying pain, but from sheer asphyxia or suffocation, as a consequence of the imperfect aëration of the blood, as just explained. When this untoward result does not happen, or is postponed to a later period, the "stitch" in the side may disappear; either because of the inflamed portion of the membrane having become adherent to its apposed part, or from these apposed surfaces having become separated from each other by the effusion between them of a watery fluid (termed *serum*) secreted by the inflamed pleura. In the former case, the parts thus *glued*, as it were, together, will probably always thereafter remain in that condition, and with no greater discomfort to the patient, perhaps, than a feeling of tightness at the affected spot on endeavouring to take a deep inspiration,—as after unusual exertion, &c. In the latter circumstance, however, certain events might follow more or less unfavourable to the patient's future health; but in a fortunate case he may altogether recover. One of the events here alluded to is *dropsy of the pleura*,—that is, the presence in the plural sac, or the space included between the costal and pulmonary portions of the pleura, of an excessive quantity of the watery fluid, *serum*, just mentioned as accompanying certain cases of pleurisy. As this serum increases more and more in quantity, the corresponding lung becomes more and more compressed, and squeezed, and reduced in bulk, by the pressure of the effused fluid, so that full dilatation of the air-cells becomes quite impossible; and the patient, in order to keep up due aëration of the blood, has proportionately to increase the number of his respirations,—that is, he becomes short-winded, and more especially so, of course, on unusual exertion. His heart, too, often becomes hampered in its movements in consequence of this pressure from the serum; or, as sometimes happens, when the fluid is very abundant, it may be pushed out of its proper place altogether. And these disturbances and interferences with the action of the heart soon gives rise to palpitations of the organ, to attacks of faintness, and other distressing troubles. Occasionally, the quantity of fluid secreted becomes so great that the lungs ultimately become unable to recede further from the surface, or to diminish further in bulk; and then the chest-walls, on the affected side, begin themselves to yield to the inward distension, and to become more or less bulged outwards in consequence. In this case, the whole of that side of the chest measures larger than its fellow, by perhaps several inches, and the spaces between the ribs become markedly prominent to the eye.

By appropriate medical treatment, the effused fluid may become re-absorbed. Or, as happens in some cases, where this comparatively slow method of removing the fluid cannot, for sundry reasons, be adopted,—as the low condition of the patient's powers, or where suffocation is imminent, &c.,—the fluid may be let out by a surgical operation. In either of these methods of procedure, the compressed and collapsed lung may recover itself, and gradually distend to its original bulk; the patient finally recovering its full use and effectiveness. Or, on the contrary, as occasionally happens,—the lung having lost its elasticity, or certain changes of another kind having taken place in its structure, or in the immediate neighbouring parts,—it may never again become pervious to the inspired air, but remain, ever after, squeezed, and pressed up against the backbone,—a useless and inert mass of organic matter. The chest-walls, being now no longer kept distended, either by the lung or the serous fluid, begin, as the fluid disappears, to fall inwards towards the shrunken lung,—being forced downwards by atmospheric pressure from without,—and the affected side thus becomes flattened and crushed, and its measurement proportionately diminished. When this condition is brought about, it generally results in weakness of the side affected, so that the patient is unable to stand perfectly upright, and when walking, to perform this act in a somewhat contorted manner.

At other times, the effused fluid, instead of *continuing serous*, becomes *purulent;* and then the shortness of breath, the palpitation of the heart, and the falling-in of the chest-walls, grave as these events occasionally are, become comparatively mild evils when compared with the ill effects attending the presence of pus in the pleural sacs. For, in the latter case, and except the constitutional powers of the patient be more than usually good, the drain upon him is so severe that he will probably sink under it altogether.

When both sides of the chest are implicated, the prognosis is, of course, much more grave, and more especially if purulent matter is found to occupy both the pleural cavities.

Accompanying the "stitch" in the side, there are also one or other, or all combined, of the following conditions—namely, fever, cold shiverings, often a short dry cough, headache, loss of appetite, thirst, costiveness of the bowels, highly-coloured urine, gravel, and the other usual concomitants of a feverish state of the system.

The most common causes of pleurisy are cold, rheumatism, gout, or the presence in the system of the *materies morbi* of these diseases; pneumonia; certain constitutional diseases,—as Bright's disease of the kidneys, consumption, &c.,—and sudden changes of temperature. Such conditions and circumstances, in short, as we found to be the most common causes of bronchitis, inflammation of the larynx, &c. &c.

The treatment to be advised in pleurisy is, to commence with, pretty similar to that recommended for bronchitis, pneumonia, &c., and to these chapters the reader is therefore advised to turn. Proper medical attendance should, of course, be obtained, and the sooner after the symptoms given above have begun to appear, the better. Till the arrival of the medical man, the measures recommended by way of home treatment, under the chapters bronchitis, &c., may be put in force. It is of the highest importance to have the disease arrested as speedily as possible, in order that large quantities of serum may not be effused within the plural sacs, and that the formation of pus,—which we have seen to be of still graver moment to the patient,—may be entirely prevented. Hence the recommendation, here repeated, to obtain the services at the outset of a responsible medical attendant, who knows exactly what the condition of matters is, what to expect, how to prevent complications, and to remove them when they arise.

CHAPTER XI.

SPITTING OF BLOOD ("HÆMOPTYSIS").

SPITTING of blood may be considered rather as a *symptom* of disease than as a disease itself—except, indeed, when the hæmoptysis is profuse, or is of long duration; in which circumstances, owing to the greatly debilitating effects it exercises upon the system at large, it may then be regarded in the light of a disease proper.

The blood spitted up may have many sources of origin; but it comes generally, and particularly when frequent or persistent, from the lungs, or the deeper and finer air-passages, and is a common accompaniment of consumption. Amongst the causes or circumstances that may give rise to it, we may also name the following:—severe congestion or inflammation of the lungs, or of the air-passages; the presence in the latter of certain tumours, abscesses, ulcerations, &c. &c. Sometimes the blood comes only from the nasal passages, from which it has trickled backwards to the top of the throat, and afterwards been coughed up and got rid of through the mouth. Or it may come directly from the mouth itself,—as from a gum-boil, or from a simple inflammation, as the result of a decayed tooth, &c. A careful examination in such cases will, however, generally reveal the superficial source of the mischief, and thus be the means of a far more favourable diagnosis being given than by *supposing* it to come from the lungs. When it is found to proceed from the lungs,—and this is what is technically understood by the term hæmoptysis,—and when it is persistent, or of frequent recurrence, it may generally be looked upon in an unfavourable light; and a careful medical examination of the lungs will probably reveal the presence of phthisis in the subject. When blood comes from the stomach, the gullet, &c., it is generally of a dark, grumous appearance, something like coffee; but when from the lungs, &c., it is always of a bright scarlet colour.

A person who is the subject of hæmoptysis should obtain proper medical advice at once. For, if the cause of the bleeding be trifling, it can soon be put to rights, and the patient's mind thus speedily relieved of the feeling that he may be the subject of consumption; and if, on the contrary, the bleeding has a deeper origin, and therefore a graver significance, the sooner the case comes under intelligent treatment the better for the patient's chance of recovery. The appeals of quacks of every kind and degree,—and this country literally teems with those who claim to be in possession of untold numbers of "specifics" for the cure of this, amongst other human troubles,—should be obstinately resisted, and their "wonderful cures" avoided, as so much poison.

CHAPTER XII.

THE QUINCYS ("TONSILLITIS").

THE tonsils are two small glands, about the size of a split almond-nut, situated (one at each side) between the *pillars of the fauces*, as explained at page 123,—that is, right at the back of the mouth, immediately before the pharynx is reached. Their function is to lubricate (by means of a fluid which they secrete) the food, during its temporary contact with them, as it passes backwards from the mouth to the gullet. When these glands become the seat of inflammation, the affection is termed *the quincys*, or *tonsillitis*,—a disease of very common occurrence in this country.

The commencement of the attack is characterised by a sense of fulness, and more or less soreness, at the top of the throat, and at one or both sides,—according as one or both glands be affected,—just below the angle of the jaw. The pain complained of is greatly increased by swallowing; and as the disease advances, the act becomes positively distressing, so that the patient endeavours as much as possible to avoid it. The speech, too, is early affected,—conversation being carried on in a stuffy, guttural tone, as if the mouth were full of food, &c. Accompanying these symptoms are also more or less fever, cold shiverings, perhaps a cough, shooting pains to the ear, a greater or less degree of deafness, inability to swallow food, not only from the acuteness of the pain which such an act engenders, but actually at times (in consequence of the excessively swollen state of the tonsils and adjoining parts) from any attempt at deglutition being frustrated by the more or less complete return of the food through the nostrils. After a day or two the inflammatory action may subside. Or the morbid process may go on to suppuration, an abscess forming, and afterwards bursting, with immediate relief to the patient's distress. In the course of a day or two more, the pain disappears, leaving the tonsils, however, in a permanently enlarged condition, and in a state of increased sensitiveness, which renders them more liable than before the attack to take-on again inflammatory action, especially when the subject catches cold.

This permanent enlargement of the tonsils, particularly if well marked, seriously affects the character of the speech, and interferes, more or less, with the formation and evolution of clear, sonorous notes in singing, &c. Moreover, if the inflammatory attack have been many times repeated, the tonsils may become so much augmented in size as to interfere seriously with the function of respiration : the mouth needing to be kept more or less widely open for the purpose. Such a condition of matters is, to say the least of it, extremely inconvenient to the person afflicted, and very pitiable for the friends to witness, as it often gives to the sufferer quite an idiotic appearance. Children, in such extreme cases, have often to be awoke out of sleep, from a feeling on the part of the parents that immediate suffocation is impending.

The most frequent cause of quincys is an attack of cold, and particularly if caught while standing in a draught. It may also arise from loud and prolonged speaking, shouting, &c., and all the more readily if these acts take place in cold, damp air. Carelessness and indifference about damp and cold feet is another fruitful source of quincys; also, a previous attack of the disease. It may be mentioned here that in certain constitutional diseases,—as scarlatina, diphtheria, &c.,—the tonsils become implicated—the inflammatory action being often very severe—but this is from the operation of a specific poison, and cannot be regarded as true quincys.

In the treatment of quincys, the first thing to be done is to give a smart purgative, so as to get the bowels to act freely. Afterwards, or coincidentally with the drug, a hot bath may be given; or the feet may be placed in hot mustard-and-water for ten or fifteen minutes. The patient should then be put to bed; and, by means of hot drinks, a hot-water bottle to the feet, extra blankets, &c., free perspiration should be induced. If the attack threaten to be severe, one or two leeches may be applied just below the angle of the jaw, and this part afterwards poulticed with hot linseed meal. Gargling the throat with hot water as frequently as possible, will also be of great service in relieving the tension of the engorged glands; as also the inhalation of steam from the spout of a kettle kept boiling for the purpose. It is a common and sad mistake to begin with astringent gargles, or to have the tonsils rubbed over with caustic. Such gargles may, however, be used, and with great advantage, *towards the end of the attack*, as they then do great service by bracing up the relaxed condition of the parts. Their early employment, however, is attended not only with no benefit, but with positive harm.

When, after repeated attacks, the tonsils have become inconveniently large, and all other means of reducing them to a size consistent with comfort, &c., have failed, it may be necessary to excise them: an operation requiring a little care on the part of the surgeon, but with this, a perfectly safe procedure, and, what is very desirable, one which results in a perfect and lasting cure.

CHAPTER XIII.

DISEASES OF THE MOUTH, THE TEETH, ETC.

CONTINUING our progress from within outwards, we next come to *the mouth*, with its contained organ *the tongue*, bounded in front and at the sides by *the gums* and *teeth*, and closed anteriorly by *the lips*. All these various parts and structures are subject to disease; as are also the glands underlying the mucous membrane of the cavity; and those other glands which, though situated outside it, yet open into it by their respective outlets or mouths. The disease most commonly affecting the soft structures is inflammation, and that attacking the teeth *caries*, or their decay and death.

(*a*.) **Inflammation of the Mouth**—*pur et simple*—is of comparatively rare occurrence, if we except those parts of it lying in immediate proximity to the teeth, and resulting from the irritation set up by the decay to which the latter are so exceedingly prone. In children, *specific* inflammations,—that is, those depending upon a specific cause, as from the lodgment and growth in the mucous membrane of certain vegetable parasites, as in case of *thrush*, &c.,—are of much greater frequency, and constitute by far the chief proportion of the inflammatory affections to which the mouth is liable.

The less generally-known forms of inflammation of the mouth,—as the *vesicular*, the *follicular*, the *membranous*, the *ulcerous*, the *gangrenous*, &c., all of which are mostly peculiar to infancy,—we will content ourselves with having enumerated. But upon those forms with which the general public are most familiar, it is desirable to bestow, at least, some short consideration.

Amongst this latter class we may speak of (1) thrush; (2) mercurial inflammation, or salivation; and (3) *gingivitis*, or inflammation of the gums.

(1.) THE THRUSH.—This affection, which most commonly attacks infants at the breast,—though it may be present at any period of life,—is accompanied, if not caused by, the presence in the affected parts of a vegetable parasite, termed the *oidium albicans*,—a minute plant of a tubular construction, divided into joints, and having at the jointed parts (or at the extremities of the filaments) a multitude of bright spherical or oval bodies, termed *spores*. The parasite insinuates itself under and between the epithelial cells of the mucous membrane lining the mouth, tongue, lips, top of the throat, &c.; and sometimes extends itself downwards into the gullet, the stomach, and intestines, producing vomiting, purging, &c. Or it may find its way down the trachea into the breathing tubes, giving rise to distressing fits of coughing, &c. The effect of the growth upon the part itself is, that the epithelium implicated becomes swollen, loosened, and easily detached, giving rise to dirty white patches of a roundish form, and of various sizes, and which, becoming softened and apparently rotten, eventually fall of. The time occupied by these changes varies from a-half to several days. The denuded, raw-looking surface may now take-on healthy action, and recovery take place. Or, on the contrary, it may again become the seat of the growth of the fungus, which, as it again comes to maturity, once more falls off like its predecessor, leaving the part naked as before. And this process may continue for a long period,—the disease not disappearing until the parasite, by medicinal or other means, is entirely destroyed or dislodged from its chosen ground. In infants, thrush sometimes causes death; the little patients,—owing, amongst other causes, to the tender condition of their mouths, &c.,—refusing food. Or, obstinate diarrhœa may set in, and, with one thing and another, their little strength soon becomes exhausted.

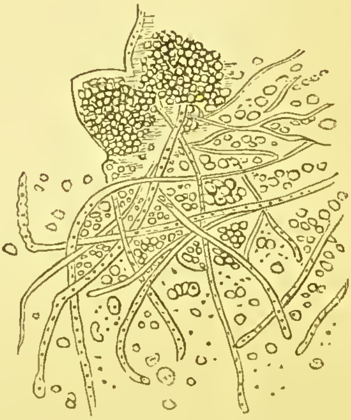


FIG. 33.

THE THRUSH PARASITE (the *Oidium Albicans*) highly magnified.

The disease is contagious, but particularly amongst young children, in whom the lining membrane of the mouth is so thin and delicate. It will readily pass from one child to another living in the same room, and under the same conditions. The fungus, which is represented in the margin (Fig. 33), is supposed by some to be derived, in the first instance, from some *mouldy* article, this having come in contact with the child's mouth or lips.

Treatment.—A mixture of borax and honey has long been a popular and efficient remedy for the thrush; and as this is also a fairly safe application, and one, moreover, requiring no excessive care in its employment, it may be preferably recommended to the more potent, but, at the same time, less safe remedies, except when the latter are in the hands of persons thoroughly acquainted with all their properties and therapeutical effects.

The borax preparation (one of borax to seven of honey) should be applied with a camel-hair brush, &c., to the whole of the white patches, which should be carefully looked for, and the painting with the preparation should be frequent,—every hour or so. Or, the mouth may be carefully and thoroughly rinsed out with the mixture. As regards a speedy cure, a great deal depends upon catching the disease at the outset; if much delay arise in applying the remedy, it may assume a severe character, rendering medical advice necessary. Indeed, when diarrhœa, vomiting, difficulty of breathing, &c., set in, it would be highly culpable in the parent to delay sending for a medical man, even for a single hour.

(2.) MERCURIAL INFLAMMATION, OR SALIVATION.—This disease depends, as its name implies, upon the effects on the system of mercury, or of some of its preparations, and results, most commonly, from its improper or inordinate administration by ignorant persons. It also arises, but less frequently, from its use in the arts and manufactures; the workmen engaged in certain of these branches having constantly to handle the drug, and, in some cases, even to inhale its fumes. Again, there are also those slight cases in which salivation is induced by the physician for the cure of certain special diseases. Some persons are found to be exceedingly susceptible to the influence of the drug, and very speedily take-on this special kind of inflammation. On the other hand, children in arms bear it much better even than adults, and require generally, pretty large and frequent doses to bring them under its specific influence. Hence the affection is almost entirely confined to grown-up people.

Salivation is characterised by a red, swollen, tender, and spongy condition of the mouth, including the gums, lips, cheeks, &c., and often the tongue. The teeth become loose, and are apt to fall out. The gums, even on slight pressure with the finger, are liable to bleed or to exude purulent matter. There are swelling and tenderness of the various salivary glands, both within and without the mouth, with an increase in the amount of their secreted fluid, and sometimes to such a degree that the saliva dribbles continually out of the mouth. The subject, owing to the difficulty he experiences in mastication, cannot partake of solid food, and his breath is exceedingly offensive,—a very characteristic symptom of the disease. In time, if the disease progresses from bad to worse, ulcers form within the mouth, on the lips, the gums, sides of the tongue, &c., and these, on the slightest pressure, discharge blood. The voice is husky or entirely gone, and altogether the patient presents a most pitiable spectacle, and never fails to enlist the sympathies and commiseration of his friends.

In the treatment of this form of inflammation, we largely employ astringent gargles,—such as a solution of alum, sulphate of zinc, &c.,—and treat the other symptoms, as they arise, by remedies proper to their peculiar requirements. It is always best, however, to place the case under the charge of a properly qualified medical man, as much mischief may accrue to the system by even trifling delay.

(3.) GINGIVITIS, OR INFLAMMATION OF THE GUMS is a frequent, but generally a trifling, affection. It is most common in infants and young children during the period of dentition. It is also a very constant accompaniment of bad or decayed teeth.

The gums, at the source of irritation, become red, swollen, and very tender, often bleeding; and sometimes, when the inflammatory action is severe, they become the seat of numerous small abscesses, &c. As the principal cause is dependent upon irritation from the presence of bad teeth, our attention should chiefly be directed to the latter in our efforts at removing the inflammation. Decayed and useless teeth should be extracted, and the mouth frequently rinsed out with water as hot as can be borne. The food taken should be such as to require the minimum amount of mastication,—broths, soups, rice-milk, &c., being the principal items of diet. And the bowels, if not already sufficiently open, should be well cleared out with a smart purgative. In severe or obstinate cases, consult a properly qualified medical man.

(4.) AFFECTIONS OF THE TEETH.—The teeth are the most prone, perhaps, of any structures of the body to get out of order, and to give rise, as nearly every one from personal experience knows, to most intolerable pain, in the form of toothache, tic, &c. Their decay and death (*caries*) in the adult (we will not speak of the troubles incidental to infants when "cutting their teeth") are, in nearly every case, followed or accompanied by frequent pangs of torture at the part diseased, or in the immediate vicinity. The pain destroys the comfort, not only of the real sufferers themselves, but also of those about them, and is, besides, destructive to the general health of the afflicted person. For the effect upon the voice of bad or broken teeth, or of defect in their number or arrangement, see page 124, where these matters have been already discussed.

CARIES OF THE TEETH is the result of several causes, the chief of these being the want of cleanliness of the teeth; the chewing of hard, brittle, or other unyielding substances, these cracking the enamel; the drinking of acid fluids, or the frequent eating of acid fruits, sweets, &c., without the precaution of subsequently cleansing the mouth; in great smokers, the friction of the stem of the tobacco-pipe; the corroding action of certain chemicals, imbibed adventitiously or incautiously administered by way of medicine, &c.; the effect upon the system of the imbibition of phosphorus, incidental to the workmen in certain of the arts and manufactures; and, in some cases, from the effects of certain constitutional diseases,—as when there is a deficiency of bone-forming material, &c., in the system. When the enamel of a tooth has become eroded or cracked by any of the above, or other means, the subsequent decay of the tooth is a work of comparatively short duration, and especially if the teeth be not thoroughly and frequently cleansed of all particles of decomposing organic matters that find lodgment in the crack or cavity, every time the individual partakes of food. The little hollow having at last, by a continuation of the eroding process, extended itself into the deep parts of the tooth, the nerve is reached; and the continual irritation of this by the corrupted matter with which the excavation is charged, gives rise to those distressing paroxysms of toothache, &c., which are of such frequent occurrence nowadays; and, generally, to the ultimate and complete destruction of the tooth, the presence of gumboils, and of other distressing ills and troubles.

Toothache, Tic-Doloreux, &c.—These distressing, and often excruciating, torments arise most commonly, as we have just seen, from the presence in the mouth of bad and decayed teeth. But, besides this, there are numerous other causes—especially of tic; and these, or rather the chief of them, are the following—namely, living in low and damp situations; the constitutional weaknesses, termed respectively the hysterical and the rheumatic diatheses or predispositions; residing in a malarious locality; derangements of some of the internal organs; a loaded state of the bowels, or the presence of worms in them; disease, or functional disturbance of the liver, the kidneys, &c.; all weakening ailments—especially the prolonged suckling by women of their infants; the change of life; the frequent drinking of tea—a very injurious habit, to which many persons are much addicted; and a few other circumstances and conditions, both of a local and general character. Anæmic females are especially great sufferers from neuralgic complaints.*

Treatment.—The first thing to be done is to see to the teeth, upon the preservation of which the greatest care should be bestowed. With this view, they should be thoroughly cleansed, not only with a tooth-brush (which should be of a soft and smooth make), but by washing well with aired water,—in which a little salt may be dissolved,—*immediately after having partaken of food.* For as the main object of brushing the teeth is to cleanse them of all particles of food, &c., it is manifestly quite insufficient to perform the act once a-day merely, and this only,—as is usually the case,—in the mornings, and thus to postpone the operation until the foreign matters lodged between the teeth have become more or less putrescent, and have by that time exercised their eroding action upon the enamel. It is, of course, far better at once to get rid of the source of danger by thoroughly cleansing the mouth *immediately after* food, when the teeth are naturally more loaded with matters than at other times. After every meal, therefore, water should be forcibly sucked into the mouth, and *through the teeth*,—the jaws being held slightly apart for this purpose,—and then forced out again. The operation should be performed several times, so as effectually to wash out every particle of matter that may have become lodged between them, and thus got rid of before it has had time to decay, and to exert upon them its injurious and corroding action. In addition to this salutary precaution, the teeth may be cleansed night and morning,—though not roughly,—with a soft brush dipped in fine charcoal dust, and afterwards with a little salt and water.

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* See a small pamphlet on "Neuralgia" by the author.

The above recommendations are given by way of *prevention* of tooth decay, which, as we have been often truthfully informed, "is far better than cure." When, however, a tooth has *become* carious, active *treatment* must be adopted. If the decay is slight, it may perhaps be arrested for several years by careful *stopping;* but if the disease be far advanced, it is much better to have the tooth extracted, if at all troublesome to the owner.

If the toothache be found to arise from some other cause than dental decay, this must be carefully attended to, and when set right, the toothache, &c., will also disappear. In obscure cases, the general health may be improved. Or, if the district in which the sufferer lives happens to be of a malarious character, he should, if possible, remove from it,—at any rate, till the neuralgic troubles are dissipated. And so, also, with respect to low-lying districts; these should be abandoned for a dry, sandy locality, and sea-bathing and other invigorating exercises intelligently followed. These instructions are, of course, of a general character, and are not intended to satisfy even a fraction of neuralgic affections, much less to replace the services of a careful medical adviser, who in the majority of these cases should be early consulted, and his instructions conscientiously carried out.

CHAPTER XIV.

DISEASES AND ALTERATIONS AFFECTING THE TONGUE.

THE tongue, which, in the articulation of words, is, as we have seen (see p. 116), one of the most important organs of the whole vocal apparatus, is very much subject to various changes and diseases, but chiefly, however, of a temporary character.

The appearance presented by the tongue is, as we know, of the highest importance to the physician, for its various changes are so many expressions of certain functional disturbances, or actual diseases, of other parts of the body. In its normal and healthy condition, and in the majority of persons, the organ presents a clean, moist, and uniformly reddish colour; but in certain abnormal states of the system,—more especially in disorders of the stomach, bowels, &c.,—it becomes more or less streaked, or entirely covered, with a *furry coat.* In other cases it may assume, on the one hand, a uniformly pale, or, on the other hand, an unusually florid, hue. It also presents differences in size, and in compactness. And it varies in the manner in which it is protruded from the mouth; this action being generally performed, when the person is in good health, with firmness, steadiness, and sudden-ness. But in disturbances of the nervous system, for example, the act may be accomplished with more or less difficulty, and with tremulousness of the organ. All these various aspects prove highly serviceable, as we have remarked, to the medical man,—as being indications of particular states or disturbances of certain of the internal organs, or of the system at large. In a feverish condition, for example, we should find the tongue dry, perhaps parched, small, and covered with a coating of yellowish, or yellowish-brown fur,—the secretion of mucus arrested, rendering articulation a matter of more or less difficulty,--and especially as the secretions from the whole of the mouth are also generally arrested. At times, the organ becomes so much parched that it presents the appearance of a piece of scorched leather, in which case there may also be partial or complete suppression of the sense of taste. At other times, again,—as in mercurial salivation,—the organ may become greatly enlarged; so much so, indeed, as completely to fill the cavity of the mouth, and even to protrude from between the teeth,—the pressure of the tongue against these being so great that it becomes indented by them along its edges, forming, as it were, a mould of their various shapes and irregularities.

Simple Inflammation of the Tongue.—In this disease, the organ becomes red, painful, and swollen; the degree to which the redness, &c., attain, being generally in proportion to the severity of the attack. The pain, which is often severe, becomes greatly increased by the mastication of food, or by the pressure of the finger upon it, by talking, or, indeed, by any other act by which the organ is brought into action. Its secretion, which at first becomes arrested, is afterwards increased in quantity, and then changed into a thick and viscid character. If the inflammatory action be severe, the swelling may become so great as to interfere seriously with the patient's power of taking nourishment, and even, if unusually violent, with the function of respiration. And in the latter case, one or more abscesses may form in the interior of the organ; and the inflammation may run to such a height, and the patient's constitutional powers may be so feeble, that mortification of the organ might supervene, and the sufferer lose part, at least, of that member, if not the whole, or perhaps even lose his life.

When the affection is of limited extent, the action is confined chiefly to a swelling on one side or surface; and this swelling ultimately suppurating, and then bursting, leaves an ulcer of greater or less depth, which heals slowly, and is the cause of much pain and annoyance. This localised form of the disease is most commonly caused by disorders of the stomach and bowels; and in our treatment, we must first direct our attention to these parts,—clearing out the bowels if necessary, correcting irregularities of the functions of the stomach,—and *afterwards* attending particularly to the local tumour or sore. General inflammation of the tongue, though rare, is a dangerous disease, and requires the prompt attention of a medical man;

all trifling and experimentation by friends should be discouraged, and even altogether discountenanced.

Tumours of the Tongue, other than those just spoken of, as arising from simple localised inflammation, it is beyond our limits even to particularise; as their profitable consideration would pre-suppose a more or less intimate acquaintance with a number of collateral subjects, with which the general public are not supposed, or expected to be, conversant.

CHAPTER XV.

RANULA, ELONGATION OF THE UVULA, AND CLERGYMAN'S SORE THROAT.

(*a.*) **Ranula** is the name given to a particular kind of tumour, situated beneath the tongue, in front—that is, under its tip. It is of a softish consistence, and of a fluctuating character. At times, it may disappear for a certain period, and again refill. It is generally thought to arise from the blocking up of the orifice of the sub-maxillary duct—that is, the duct leading from the sub-maxillary gland (see page 112.) The annexed figure (Fig. 34) represents the appearance usually assumed by the tumour.

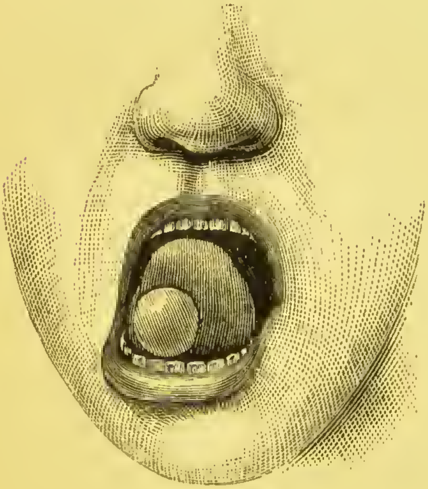

FIG. 34.

RANULA.

The contained fluid may at first be purely the secretion from the sub-maxillary gland ; the flow of which fluid into the mouth, having become arrested by closure of the orifice of the excretory duct, the imprisoned fluid dilates the tube, and so produces the tumour. If, however, the tumour has long been present, the contained fluid may have changed in character, and have become purulent, &c.

The common *cause* of ranula is inflammation of the tongue, or of the duct itself, or of the floor of the mouth, or of the parts immediately adjacent.

Treatment.—The tumour may generally be got rid of by cutting a portion of it out with a small pair of scissors, or other suitable instrument, by which means free exit is given to the pent-up fluid, the swelling thereupon shrivelling up, until it finally disappears altogether. The operation, simple as it appears, should not, however, be attempted except by the surgeon, as there is a possibility of wounding the main artery of the tongue, which lies in close proximity to the ranula.

(*b.*) **Elongation of the Uvula.**—The uvula, or little tongue, is, as we have learnt (see page 104), the small pendulous prolongation backwards of the soft palate. It is normally of small size; but it is subject to inflammatory action, and a consequent increase in its length, whenever the tonsils happen to be affected with inflammation. If the elongation of the uvula become much marked, it may be of sufficient length to reach down to, and touch, the back of the tongue; in which case it produces continuous irritation at the top of the throat, and a persistent tickling cough, which prove excessively troublesome and annoying to the patient. But besides this, the constant attempts of the patient to cough, or hawk up, what appears to him to be a piece of solidified phlegm, or other similar substance, induces, in course of time, a congested, or even an inflamed, condition of the neighbouring soft structures,—as the tonsils, the whole of the soft palate, the pharynx, the epiglottis, and even occasionally of a portion of the interior of the larynx,—with consequent weakness and relaxation of these parts, and the production of hoarseness and huskiness of the voice, and other troubles.

The remedy consists in excising a portion of the elongated uvula, and the subsequent removal, by appropriate astringents and other remedies, of the relaxed condition of the adjacent structures. Often have years of petty, but incessant and vexatious, annoyance,—for the removal of which an untold number of "remedies," so-called, have been vainly tried,—been at once got rid of by the simple expedient of shortening the lengthened uvula. And often have rustiness and roughness of the voice,—for which every kind of treatment has been fruitlessly adopted,—been immediately dissipated by the discovery of an inquisitive medical man of an elongated uvula, and the subsequent removal of its tip ; the voice returning with all its wonted clearness and healthy "ring," to the no small gratitude of the hitherto despondent subjects of these troubles, and especially if dependent to a greater or less degree on the integrity of their vocal powers,—as are vocalists, public speakers, &c.

(*c.*) **Clergyman's Sore Throat.**—The relaxed condition of the parts just enumerated, and the increased length of the uvula, as just described, constitutes what is termed "clergyman's sore throat;" these gentlemen,—and, indeed, all public speakers, who exercise their vocal powers more or less constantly,—being very prone to the affection. Delay in seeking proper medical advice in these cases, is the cause, not only of much needless annoyance to the person affected, but of greatly increased difficulty to the medical adviser, in restoring the tone of the implicated structures, and the integrity, therefore, of the voice. For, the due tonicity of the whole of these structures is required if the voice is to be clear, whether in speaking or singing; and here, as elsewhere in the body, the longer an abnormality has lasted, the more time, as a rule, is there required to undo the mischief. The uvula is, of course, easily shortened when its abnormal length is the fountain of the troubles in question; but it requires a certain length of time,—and longer in proportion to the duration of the abnormalities,—to brace up to a due pitch of tonicity the *neighbouring* relaxed tissues.

CHAPTER XVI.

AFFECTIONS OF THE NOSTRILS, THE NOSE, AND THE LIPS.

(*A.*) **The Nostrils.**—The diseases to which the *nares* or nostrils are subject, are many and important. There may, for example, be abscesses, ulcers, fissures, necroses (death of the bony parts of the nasal cavities), tumours, coryza, epistaxis, and other diseases and abnormalities. The diseases which will come under our notice, however, are coryza, epistaxis, and polypus.

(*a.*) CORYZA.—This is the name given to a cold in the nose, which is characterised by an inflamed condition of its lining membrane, and a flow therefrom of a thin, watery, and very irritating discharge, which causes repeated paroxysms of sneezing, and sometimes excoriation of the upper lip, over which it runs. Accompanying this local disturbance is fever, less or more, according to the severity of the attack; also, a sense of stuffiness in the nostrils, with, at times, temporary, though often complete, occlusion, caused by a thickened condition of the lining membrane. There are, besides, cold shiverings, a running of watery fluid from the eyes, pain at the forehead between the eyebrows, and other similar concomitants,—as in an attack of common cold, of which coryza is the most frequent accompaniment and symptom. If the attack be severe, or if not early arrested, it is liable to creep down the lining membrane into the larynx, and even into the bronchial tubes, and thus cause bronchitis, &c.; or it may pass by the same lining membrane, down the gullet, into the stomach, and even as far as the intestines, and producing corresponding troubles in these regions. As the disease subsides, the discharge from the nostrils changes in character, becomes thick and purulent, and loses its irritating properties. The pain, too, and the fever disappear; and the patient is then chiefly occupied in getting rid of the thick tenacious matter which now loads the nostrils.

While the nostrils remain in this stuffy condition,—whether from the thickened lining membrane, or from the subsequent presence of the heavy yellowish discharge,—the subject of the attack is, as we all know, quite incapable of properly pronouncing his words; the free passage of air through the nostrils being in either case prevented; and we are thus again reminded of what was advanced in a previous place (see page 128) in regard to this matter,—namely, the necessity which exists for a free passage through the nostrils, for the correct utterance of words.

As regards the *treatment of coryza*, see treatment of acute bronchitis.

(*b*.) EPISTAXIS.—Bleeding from the nose, or *epistaxis*, though usually of but trifling moment, is sometimes, more particularly in elderly persons and in young people, when very abundant or of frequent recurrence, attended with much danger and anxiety. In the young and robust, it is not at all uncommon to meet with periodical attacks of epistaxis ; but this, in those of a full habit or of a sanguineous temperament, acts upon them more in the manner of a safety-valve, and proves beneficial to them rather than otherwise. In those predisposed to it, a paroxysm of over-mental excitement, particularly of anger or passion, or carelessness about cold feet, will very frequently determine a sudden and often copious attack of epistaxis. In the aged, the fragility of the blood-vessels of the nose, as of those of all other parts of the system, render them exceedingly liable to rupture, so that a fit of sneezing, or of coughing, or an attack of cold, or a temporary coldness of the feet, or even, in some cases, the act of stooping down with the head low, is sufficient to cause rupture of the nasal vessels, and consequent hæmorrhage from them. Moreover, in aged people, the blood itself is but of poor and thin quality ; and is thus deprived to a great extent of its power of ready coagulation, in consequence of which the bleeding is more likely to be persistent in the aged than in young people.

In our *treatment of epistaxis* it is desirable, and even necessary, to keep in view the cause of the hæmorrhage, and to note the age and general constitutional powers of the subject. In persons whose *build*, habit of body, and general physique would lead us to suspect danger from apoplexy, it would be questionable wisdom to interfere with a mild case; but in the anæmic, the delicate, and the aged or very young, we may at once have recourse to repressive measures. The old-fashioned and time-honoured custom of placing a piece of cold iron, as the massive house-door key, to the back of the neck or between the shoulders, is often quite sufficient to arrest an ordinary attack. But we may also bathe the root of the nose and the forehead with cold water, placing the feet at the same time in a hot bath, and bathing as far upwards as the knees, the body being all the while kept in an upright posture, and in great feebleness, the head elevated, and maintained in this position by pillows, &c. These measures will be the more likely to succeed if the patient can be prevailed upon to keep quiet and to preserve silence; indeed, the less fuss and excitement of any kind, either on the part of the patient or the attendant friends, the better. The patient's mind should be *quieted*, not *excited*. Another good plan for arresting an attack of epistaxis is to cause the patient to hold both his hands high up above his head—as high, indeed, as possible—with his face to a wall, and his head thrown back. This is often, and in the course of a couple of minutes, quite effectual in stopping an ordinary attack. When these and other common methods have failed, it may be necessary to *plug the posterior nares*; but this can be safely done by the surgeon only, who should at once be sent for in a bad case.

Afterwards, when the immediate trouble is past, measures should be adopted to prevent a recurrence of the hæmorrhage—that is, in those cases in which the bleeding is not of a salutary nature. In the aged, the feeble, and the anæmic, every means should be adopted for improving the quality of the blood; and every care exercised on the part of the patient to guard himself from attacks of colds;—to see that his feet are kept dry and warm, to avoid heated discussions and controversies, or outbursts of passion, and other dangerous kinds of mental excitement. If he has a cough, it would be well to have it attended to; and not simply for its own sake, but from the tendency it has to jerk the blood uphill, and so to surcharge the vessels of the head, and render them more prone to rupture.

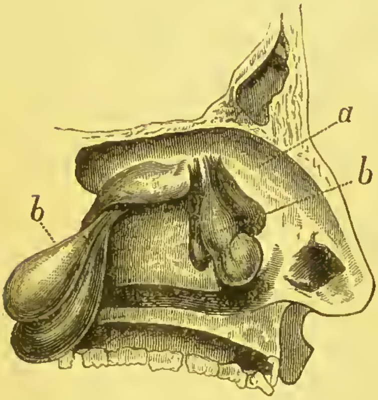

FIG. 35.
NASAL POLYPUS, left side.
(*a*) Interior of left nostril; (*bb*) groups of polypi.

(*c.*) NASAL POLYPUS.—A nasal polypus is a roundish or pear-shaped tumour, occupying one or both nasal cavities. It is generally of a reddish or purplish colour; very soft and friable; bleeding on the slightest touch; of a gelatinous consistence; and covered with moisture. Both cavities of the nose may be occupied by a polyp, or by several at one time. The attachment of the tumour is generally by a narrow neck, and most commonly to the edge of one of the thin curled-up bones (mostly the lowest), on the external wall of the cavity, never to the thin plate of bone (the vomer) that divides the interior of the nose into two cavities.

It will readily be imagined that the subject of nasal polypus must experience in a greater or less degree, an impediment to the passage of air through his nostrils; and this will also, as we have seen, be attended with a corresponding degree of imperfection in the pronunciation of his words. And such is the case; the degree of interruption being dependent upon the size or number of the obstructing bodies. Occasionally, the polyp is of sufficient size to completely block up the nasal passage; or to project backward down into the pharynx; or to cause a bulging out of one side of the nose, thus distorting the features; and in some cases even to cause destruction of one or more of the nasal bones, by the pressure it exercises against them.

The best remedy is to take them out of the passage bodily, and each one separately, by seizing and twisting it off by the root or pedicle by which it is attached to the nasal bone. But this should, of course, be the work of the surgeon, as, amongst other reasons, rather free hæmorrhage is apt to arise during its extirpation.

(*B.*) **The Nose.**—The cartilages of the nose are occasionally the seat of disease of a rather serious kind; so serious, indeed, at times, as to result in their utter destruction; thus leaving the cavities of the nose exposed to the public gaze, and completly marring the sufferer's physiognomy. As in case of the person represented in Fig. 36, for example. Accident also, as well as disease, may, of course, deprive a person of this important feature of his countenance, either partially or wholly; and so completely to spoil the individual's features, that he is often glad to hide his face from public view.

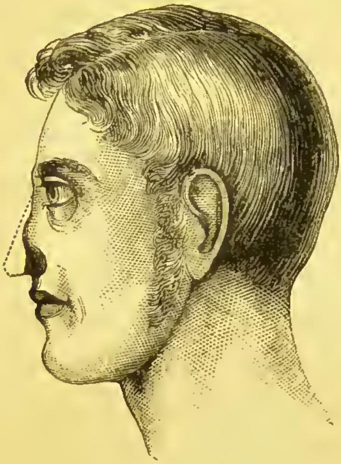

FIG. 36.

LOSS OF THE TIP OF THE NOSE FROM DISEASE: the dotted outline shows the part lost.

It fortunately happens, however, that such deformities can, in very many cases, be almost entirely removed by operation; and such operations are, indeed, amongst the most pleasing triumphs of the surgeon's art. But more especially is this the case when, the patient being young, and having no special constitutional disease to battle with, the organ has been lost or mutilated by *accident*. Striking as the statement may be, it is nevertheless true that a new nose can be formed from the forehead and elsewhere,—that this new nose can be applied to the seat occupied by the original organ,—and that the patient's features can, in the course of a few weeks, or even less, be made to assume a com-

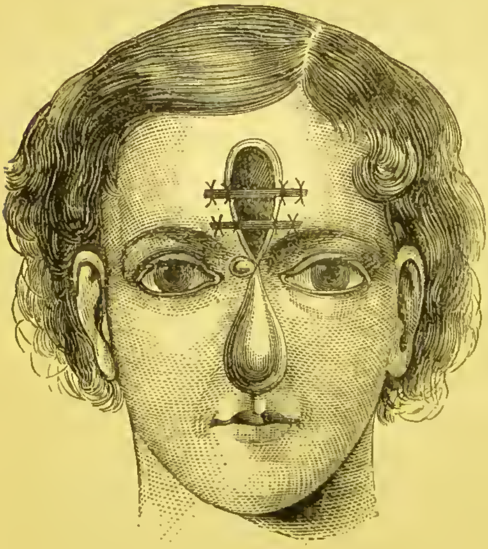

FIG. 37.

SHOWING HOW A NEW NOSE IS FORMED FROM THE FOREHEAD.

paratively natural and pleasing appearance. Fig. 37 conveys a rough idea of the means generally adopted for the accomplishment of this object; and Fig. 38 shows the ultimate result of the operation,—the slight scar left on the forehead (from which the nose was cut) being anything but disfiguring, and presenting not a fraction, certainly, of the deformity for which the operation was undertaken.

(*C.*) **The Lips** are very frequently subject to certain diseases, chiefly ERUPTIONS, arising from attacks of common cold, or from stomach derangements, and inattention to the state of the bowels. These eruptions mostly consist of small blisters, arranged in clusters, on a red base, termed *herpes;* or of patches of scabby sores, discharging a sticky glutinous matter, which often possesses the property of producing a like sore on any other part of the body with which it may come in contact; or of small ulcers,—the favourite seat of which is at the corners or angles of the mouth.

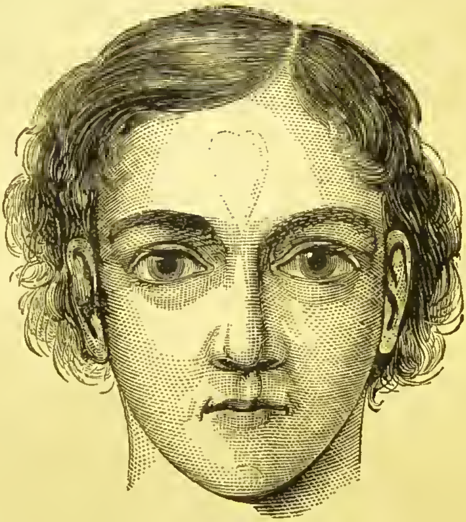

FIG. 38.

RESULT OF OPERATION FOR NEW NOSE, performed on person represented in Fig. 37.

The treatment of these various troubles consists in first setting the bowels to rights (they are generally found to be costive in these cases), and afterwards in restoring the lost tone of the stomach. The patient may live for a few days on light but nourishing food,—as rice, broths of various kinds, boiled milk with bread, &c.;—but if after these measures have been tried, and the case proves obstinate, the liver will probably be found out of order, and will require the special attention of the medical man.

Hare-Lip.—This is the name given to a congenital defect in the upper lip, consisting, most commonly, of a want of union, or, in a bad case, of want of substance, in the middle line of the lip, as represented in the annexed figure (Fig. 39.) Occasionally, moreover, there is also found a deficiency at *each side of* the mesial line, with a small irregular fleshy projection hanging downwards into the fissure from the nose.

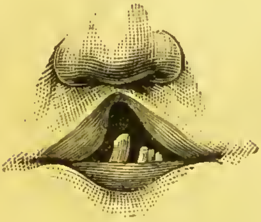

FIG. 39.
HARE-LIP.

Accompanying the hare-lip, we may also find that the hard palate,—namely, the roof of the mouth,—is more or less defective in the middle line. In which case there will be one continuous fissure from the upper lip to the back of the mouth, causing the cavities of the mouth and nostrils directly to communicate with each other, and thus to constitute what is termed CLEFT PALATE. This latter condition of matters is, as will readily be imagined, quite incompatible with correct pronunciation of words; and is one, moreover, in which the attempt at articulation is generally attended with very disagreeable effects upon the auditor, especially if the fissure be wide and well marked.

As in the case of destruction of the tip of the nose, and similar deformities, the art of the surgeon admits, generally, of effecting a complete and permanent cure, both of the disfiguration in the lip and the more serious defect in the roof of the mouth. With regard to the latter abnormality, it has long been the custom to supply by mechanical means what has thus been left by nature in an unfinished state, by carefully adjusting a thin metallic or other plate to the roof of the mouth, and so to form an artificial partition between the latter cavity and the nostrils. Indeed, without some such aid, it is almost impossible in a bad case,—and always difficult,—to perform the act of deglutition. A merely mechanical method, however, of supplying a roof to the mouth, though highly convenient, and in some cases indispensable, cannot, of course, be compared to the roof ordinarily furnished by nature, nor to that formed by the skill of the surgeon from the neighbouring natural structures. Yet, in cases where, from some constitutional or local peculiarity, a new roof cannot be obtained from the natural structures by operative measures, recourse to the above purely mechanical expedient of supplying the deficiency may be advantageous.

For the defect in the lip there is no method of cure except that of a surgical operation. And as this, with ordinary care, and in ninety-nine cases out of a hundred, gives a perfectly satisfactory result, the operation may be advised unhesitatingly whenever it is possible.

CHAPTER XVII.

BAD-SMELLING BREATH.

It will perhaps prove useful if, in our concluding chapter, we add a few remarks upon this subject, as there is perhaps nothing more offensive or disagreeable than to come in close proximity to a person afflicted with a bad breath. This annoying character of the expired air is dependent, generally, upon one or more of the following conditions,—namely, disorder of the digestive organs (common in habitual drunkards); the presence in the mouth of decayed or uncleansed teeth; salivation; sore throat of a malignant nature; ulcers or abscesses in the mouth or lungs, &c.; and especially is it most offensive, as we learnt, in that very fatal disease gangrene of the lung. The cause, whatever it may be, should, of course, be ascertained, and then steps at once taken towards its immediate removal. It is a foolish practice to attempt to mask or overpower a bad-smelling breath with odoriferous drugs or spices, since, by the adoption of such proceedings, the root of the evil is not only left unattacked, and no permanent benefit therefore experienced, but it is highly probable, from the cause itself being by such means left untouched, that the mischief will become increased rather than diminished. If the breath be offensive, there is a cause for it, and this, both for the sake of the owner's comfort and health, and for the comfort, at least, of others, should be carefully searched for, and when found, at once got rid of; not, we repeat, by *masking* or overpowering it with substances of the nature above indicated, but by its complete and absolute destruction at the fountain head.

FINIS.

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